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FEASIBILITY STUDY OF THE REVERSAL OF TRAFFIC FLOW ON THE ATLANTA NORTH FREEWAYS DURING PEAK HOURS

A Thesis

Presented to

The Faculty of the Graduate Division

by

Robert Leroy Martin

In Partial Fulfillment

of the Requirements for the Degree

Master of Science in Civil Engineering

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FEASIBILITY STUDY OF THE REVERSAL OF TRAFFIC

FLOW ON THE ATLANTA NORTH FREEWAYS

DURING PEAK HOURS

Approved:

Date approved by Chairman March 29, 1963

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And lastly, the author wishes to dedicate this thesis to his wife, Patty, whose inspiration, encouragement and patience were of the greatest value in its preparation.

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SUMMARY

The purpose of this study is to provide a method of improving the flow of traffic during peak hours on the Atlanta North Freeways, to relieve the congestion and to add to the total capacity of the freeway and city street transportation network. The Atlanta North Freeways connect the Atlanta urban area and downtown area with the outlying suburban area and metropolitan region. Arterial streets, parallel to and crossing the freeways, provide service between these areas and the freeways.

The traffic volume encountered on the freeways is in excess of that predicted in 1955 for the year 1975. Many sections of the freeways and the arterial streets carry peak hour traffic volumes far in excess of the capacities provided. The average peak hour vehicular speeds are well below the recommended minimums. The North Freeway section between Fourteenth Street and the Northeast-Northwest Freeway Junction, a weaving section, carried over 78,000 vehicles per average weekday in both directions in 1961. The morning peak hour volume exceeds 4500 vehicles while the evening peak hour volume exceeds 4200 vehicles.

It is imperative to find a method of regulating the freeway traffic to eliminate the breakdown of the freeway system during peak hours. At the same time, the arterial

street system needs improved traffic flow. The reversal of lanes on the freeways during peak hours is investigated to meet the objective of providing improved traffic flow on the freeways and arterial streets.

The analysis of existing traffic conditions in the study area reveals that complete reversal of any portions of the freeway system would result in undue congestion throughout the transportation network. The same is true for the location of a lane reversal terminal on an interchange. It further indicates that the Northwest Freeway provides sufficient capacity for traffic at all times, therefore no lane reversal system is established on this freeway. After further study, the reversal of the median lanes of the North and Nor Northeast Freeways is considered. The traffic conditions warrant an express lane from south of Tenth Street to north of Cheshire Bridge Road (over 2000 vehicles per hour desire this route). On this basis a method of freeway lane reversal is proposed.

The recommended method of freeway lane reversal establishes the lane to the left of the median as an express lane for major direction peak hour traffic flow. During the morning peak hours, southbound traffic wishing to use the express lane will enter onto it through a median cross-over 1500 feet north of Cheshire Bridge Road and exit from it 750 feet south of Tenth Street. Evening peak hour traffic (northbound) will use the express lane by the reverse procedure. Overhead lane signs and signals will be provided to control all freeway traffic in the vicinity of the express reversible lane ingress and egress points. The opposing lanes of traffic on the side of the freeway carrying reverse flow traffic will be separated by mechanical pop-up lane dividers near the cross-overs and traffic cones between them. These dividers will also act to funnel traffic into the express lane on the ingress end and divert minor flow traffic from that lane at the egress end. Barrier gates across the median cut-overs during off-peak hours will prevent the entry of unauthorized traffic. The control of the system will be completely automatic by radio control. Refuge bays and emergency median cross-overs will be provided in the event of an accident or vehicular breakdown.

Arterial street traffic will also be more effectively controlled during peak hours to permit the successful and efficient operation of the reverse lane. Arterial streets in the vicinity of the express lane terminals will be signed and signaled to divert minor flow traffic away from the freeway and to the parallel arterial routes. All of the major arterial intersections in the study area will be provided with automatic volume density traffic signals.

This method of peak hour traffic flow reversal on the North Freeways is considered to add to the total capacity of the transportation network. The cost of the installation of such a system, $420,000, is not prohibitive when compared with the increased vehicular speeds, reduced travel times and congestion and reduced vehicle operating costs. The method is therefore considered to be a feasible one to permit the reversal of traffic flow on the Atlanta North Freeways during peak hours. Additional capacity of 1200 to 1500 vehicles per hour will be provided to the peak hour major flow traffic. The reduced capacity in the minor direction will be offset by the provision of additional capacity on the parallel arterial routes. Other changes to the arterial routes may be considered after the reverse freeway system is in operation.

CHAPTER I

INTRODUCTION

General

The Problem

The Atlanta North Freeways assume an important role in the movement of vehicles and persons to and from the Atlanta urban area and downtown central business district. These freeways mainly serve parts of Fulton, DeKalb, Cobb, and Gwinnet Counties which are those counties that contain and/or surround the area presently under study.

The North Freeway from the central business district to Peachtree Road, the Northeast Freeway from Peachtree Road to Cheshire Bridge Road, and the Northwest Freeway from Peachtree Road to Howell Mill Road were completed in 1951, 1955, and 1957, respectively. The Northeast and Northwest Freeways were further extended after 1957.

Prior to the construction of the freeways, in 1950, the population of the aforementioned four-county area was 704,117 persons. In the same year there were 207,170 registered passenger vehicles in these four counties. By 1960, the population had risen to 970,823 persons, almost a 38 per cent increase. However, the total registered passenger vehicles increased by over 65 per cent to 346,275, almost double the rate of the population increase. In 1961 there were 362,948 registered passenger vehicles and an additional 38,711 trucks (see Tables 5, 6, and 7, Appendix).

On the average weekday of 1961, 78,430 vehicles were observed on the Atlanta North Freeway north of Fourteenth Street in both directions. This amounts to almost 20 per cent of the registered vehicles in the four-county area, assuming the majority of the vehicles to be local. On this section of the freeway, the heaviest traveled section, 8,200 vehicles travel southbound in the morning peak hours of 7 A.M. to 9 A.M. In the evening from 4 P.M. to 6 P.M. 7,760 vehicles travel northbound. On a typical weekday a vehicle can only average 27.5 mph traveling to the CBD from the outlying suburbs (North Druid Hills Road, for instance).

How then can this present situation be remedied by making use of the existing facilities? "Certainly it is imperative to find a practical way to prevent urban freeways from breaking down under peak traffic loads." (1)*

The task of the study is to analyze current peak hour traffic behavior and arrive at methods to facilitate traffic flow without the costly construction of additional through lanes and acceleration and deceleration lanes. Methods of peak hour traffic flow reversal on the freeways will be inves-

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*Numbers in parentheses refer to references listed under Literature Cited.

tigated and proposed as will changes to the city street system to complement the lane reversal. "The ultimate success of the freeway depends on its ability to add capacity to the total network, without detracting either from available capacity or serviceability of the existing streets and highways." (2) If the methods of traffic flow reversal are proven feasible, it is probable that some contribution will be made towards solving the overcrowded freeway problem of Atlanta and other cities with similar traffic problems.

Nature of Study

In the past no study of this type has been undertaken for the City of Atlanta or the Atlanta Metropolitan Area. This is also the first study made on the feasibility of reversing the flow of peak hour traffic on a freeway that has served the public as a typical freeway only. Studies have been made to determine the effects on traffic flow by the closing of on and off ramps. Also, freeways have been constructed and planned with additional lanes for the express purpose of peak hour traffic flow reversal.

The present feasibility study was undertaken on the suggestion of Dr. D. O. Covault, Associate Professor of Civil Engineering at the Georgia Institute of Technology. It was deemed necessary to determine more efficient methods of using the existing freeway and city street system serving the Atlanta urban area and central business district.

Objectives

The purpose of this study is to attain a method, or methods, to reduce travel frictions on the existing north freeways and city street system of Atlanta, Georgia, so that the people and vehicles can move into and within the Atlanta urban area as rapidly and safely as possible, in a manner consistent with costs. The reversal of peak hour traffic flow on the Atlanta North Freeways will be investigated for its feasibility in meeting this objective.

Through an analysis of current traffic volume, travel time and facility capacity data, recommendations will be made for methods of reversing the flow of peak hour traffic. For each proposed method of traffic flow reversal the effects on the city street system will also be investigated. Finally, the methods will be examined to determine their feasibility in regard to safe, economical and efficient movement of vehicles in the urban area.

Present Reversible Lane Systems

> The use of reversible lanes to handle unbalanced traffic flow is not new. It has been used in many instances on surface streets and on bridges to permit a greater number of lanes in the major direction of travel. In some instances the entire flow on a single street has been reversed. The usual regulation is accomplished by signals over the appropriate lanes, by portable stanchions or by barricades. (3)

Reversible lanes have also been designed for and constructed into freeways as a separate roadway to aid in carrying peak hour traffic. The Northwest Freeway in Chicago is an excellent example. During the planning of the freeway it was discovered that the needed capacity in the major direction of peak flow was in excess of 7,000 vehicles per hour. The most practical and economical method to provide the required capacity was determined to be the addition of a physically separated, two-lane roadway in the median to handle reverse flow operations during the morning and evening peak hours.

The reversible lanes provide no intermediate ingress and egress and are closed to traffic in the off-peak hours. The control of traffic on the individual freeway lanes, traffic to and from the reversible lanes and traffic to and from the interchange area ramps is handled by a completely automatic electrical system. In case of emergency the system can be operated manually. The traffic operation problems are solved by a system of dual and changeable message signs to indicate the freeway status, color coding applicable to single conditions and lane control signals to augment the informative signs. One of the primary objectives, the achievement of proper lane balance, is reached by optimum spacing of the signs and signals near the ingress and egress points. Physical barrier gates are provided at these points to prevent unauthorized entry to or exit from the reversible lanes.

The automatic electrical control system consists of three basic components. The first component is the electrical functioning device. Each high intensity illuminated sign, each signal and each barrier gate has its own device. The second component is the electrical power distributer system for each device. At a local controller for a particular device, electrical energy is distributed to various remote controlled automatic switches which are connected to the circuits selected by the master control system. Almost every device has an individual power supply to provide better reliability. The master controller, the third component, is located in the Illinois State Highway Building in the CBD. It offers complete surveillance of the system. Programs are stored in the master controller to carry out the opening, closing and controlling of the reversible lanes.

The reversible lanes are opened to inbound traffic at 6 A.M. and are closed by 10:15 A.M. The signs, signals, and barrier gates are activated in sequence, starting from the egress end of the lanes. The operation of a succeeding control is dependent upon the confirmation of proper operation of the previous control. The reversible lanes are closed in reverse order at 10 A.M. Fifteen minutes are allowed before the barrier gate is closed to assure that the lanes are cleared of traffic. A similar operation is carried out for the evening peak hours of 3 P.M. to 7 P.M.

Refuge bays and emergency crossings are provided in the reversible lanes in the event of a vehicle breakdown or an accident. The length of the express lanes is seven miles. They operate near capacity--just under 3,000 vehicles per hour for both lanes. Speeds of 53 mph are obtained on the reversible lanes while a 40 mph speed is possible on the other freeway lanes.

Studies have shown that there is an 80 to 85 per cent obedience of lane control signs and signals. It has also been found that the freeway handles 10,000 vehicles per hour in the major direction of travel as contrasted to the predicted 8,000. (4, 5)

Another facility designed, and presently under construction, with separate reversible lanes is the Seattle Freeway in Seattle, Washington. An extensive origin-destination study and an inventory of all Seattle routes were made prior to the freeway planning. It was determined that by 1975 a route would be needed to accommodate an additional 160,000 vehicles per day, with an 85-15 directional split during the peak hours, in the maximum demand section (15,000 vehicles per hour in the major direction of flow). This situation will develop as a result of most of Seattle's industry being located on the south side of the CBD while most of the residents are on the north side. Also, the corridor of travel is limited to a two-mile strip located between Lake Washington on the east and Puget Sound on the west.

Due to the limited right-of-way and the great number of vehicles that would be encourtered, a reverse lane operation was considered to be the most feasible solution to the problem. The number of reversible lanes under construction varies. Two, three and four lanes will be provided between James Street at the southern boundary of the CBD, where the directional split is 60-40, and extending to East 110th Street, where the split is 85-15, a distance of about seven miles. No direct connections will be provided between the reversible lanes and the unidirectional lanes. However, separate on and off ramps will be provided from the reversible roadway at various points. The bridges of the freeway will have two levels. The eight unidirectional lanes will be on the upper level and the reversible lanes will be on the lower level.

One of the biggest problems, that of providing adequate capacity at the ramp terminals and beyond into the city streets, will be handled by eliminating parking and introducing additional one-way streets into the system. Proper lane balance will be provided by controlling on and off movements with gates.

Signs and signals will be of the overhead type, fairly well standardized, with changeable message signs. "The remote control of all gates, changeable signs, and signals should be possible from a central operational control office, supplemented by manual control at the site to take care of any emergencies that might arise." (6) Southbound flow will be permitted on the reversible lanes from

6 A.M. to 10 A.M. and northbound flow from 2 P.M. to 8 P.M.

Completion of the freeway is expected in 1966. The freeway is being promoted and introduced to the public by four-page leaflets that inform the people of the progress. Also, a portable scale model is being shown to the public so that they will know what to expect. (7, 8)

In addition to the two freeways discussed above, numerous streets and expressways are operating with reversible lanes in various cities throughout the United States and other countries. On Lake Shore Drive in Chicago, Illinois, 2.2 miles of "capacity providing divisional fins" allow reversal of traffic flow. Eight lanes are separated into pairs by means of retractable, mechanical dividers which operate hydraulically to provide six lanes in the major direction of flow. Each line of fins consists of a series of connected steel boxes 20 inches wide, 16 inches deep and 25 feet long. The hydraulic system permits them to be flush with the roadway when they are not in use.

Traffic control on this facility is provided by movable cones and barricades and signals and signs. The volumes in the six lanes exceed 1,600 vehicles per hour per lane and the average speed is 45 mph. An additional 8.5 miles of this expressway operates with reversible flow controlled by signs, signals, and lane markings. (9, 10, 11)

Another method of reversal has been tried and proven on an express-type facility, Lake Washington Floating Bridge

Route U.S. 10, in the vicinity of Seattle, Washington. This four-lane facility is a combination of a physically divided parkway, a tunnel and a floating concrete pontoon bridge. Traffic cones were used to separate opposing lanes (reversed median lane and outside lane) during the initial installation of this system. The average operating speed in the major direction of flow was increased from 33 to 40 mph while the speed in the single minor lane was decreased from 34 to 22 mph. The distribution of traffic in the three peak lanes was 35 per cent on the outside lane, 40 per cent on the inside lane, and 25 per cent on the reversible lane.

During the first few weeks of operation the volume in the major direction of flow increased, while that in the minor direction decreased. Breakdowns and accidents on the single minor lane resulted in congestion, however, no refuge bays were provided. Travel time decreased by 18 per cent in the peak direction and increased by 35 per cent in the opposite direction. The placing and removal of traffic cones took one and one-half hours.

In February of 1961 the manual operation of this system was replaced by an automatic lane control system. Automatically controlled overhead signals provide three lanes to peak hour traffic and one to opposing traffic. Approximately 3,500 vehicles per hour travel in the peak direction while 1,050 travel in the opposite direction. The total cost of the signals, 33 sets of six signal faces in each direction, was $191,300. The estimated net saving to the public in 30 months is $44,500. The system was proven to be effective and it was extended two miles further in August of 1961. (12, 13)

In Britain, an arrangement of fins similar to that in Chicago is proposed to provide reversal of traffic flow on broad highways feeding morning traffic into and evening traffic out of the main business district and the industrial center. The fins to be used are concrete sections 15 feet long, 12 inches deep and 9 inches wide interconnected with air piping. They will be lowered and raised by compressed air and are made by the Westinghouse Brake and Signal Company, Ltd. This same system is in operation in Belgium. (14)

The Mark Twain Expressway, part of Interstate Route 70 in St. Louis, Missouri, employs a unique system to provide traffic flow reversal. The middle two lanes of this eight-lane expressway are used for reversible flow. The ingress and egress points are opened and closed by a train "zipper" consisting of a small-scale armoured car train of 14 cars. Each car weighs 4,000 pounds and is 24 feet long, 2 feet wide and 3 feet high. The trains are pulled across the openings by cables attached to electrically controlled mechanisms. When not in use the trains are sidelined on storage tracks. An overhead signal system informs motorists of the state of the system. The cost is approximately $350,000, installed, for all five trains operating at the five entrances along the six-mile stretch of expressway. (15)

In Cleveland, Ohio, a section of a six-lane divided expressway operates to provide four lanes (one lane to the left of the median) during the evening, outbound peak. A cut-over is provided through the median strip to allow for this transition. Informative signs are posted along the right-of-way and are augmented by rubber cones set out daily to segregate opposing streams of traffic. The prevailing speed on this facility is 45 mph. (16)

Improved operational characteristics of city streets and expressways are provided in other cities by methods not as unusual as those previously discussed. Off-center lane movements and the reversal of street sections are controlled by overhead signs and lane signals, traffic cones, mountable curbs, movable barriers and signs and city police. In Syracuse, New York, radio control is used for reversible flow. (17) The Lake Washington Floating Bridge (Route U.S. 10) and Aurora Avenue in Seattle, Washington, Crittenden Drive in Louisville, Kentucky, Queensborough Bridge in New York City, part of 13th Street in Washington, D.C., and Olympic Boulevard in Los Angeles, California, are but a few of the traffic facilities operating under reversible lane channelization. (18, 19, 20)

CHAPTER II

PROCEDURE

Study Design

It was necessary to design this study based on time and budget limitations. Concurrently, the methods of analysis had to be established to utilize a minimum amount of information to satisfy the needs of the analysis. With a knowledge of traffic characteristics in the study area and established procedures of data presentation the study design was conceived. The study was further designed to its central purpose, to plan a transportation network revision in an area of consistent and orderly travel.

The Study Area

The first requirement of the study design was to define the study area. "This must include the area in which travel is already most concentrated and for which a transportation plan is most needed." (21) The area must include that region in which there is a systematic daily and hourly cycle of movement towards and away from the Atlanta urban and downtown area. (22) At the same time the area must be one in which there is a need for more efficient transportation facilities to meet the traffic demands.

Since the study is primarily concerned with the reversal of traffic flow on the Atlanta North Freeways, the study area must circumscribe the routes parallel to and serving the freeways. It must also include those routes that bring traffic to and from the freeways and serve the major movements of traffic within, into and out of the Atlanta urban and downtown areas.

The area under study conforms to the requirements stated above. The boundary line had to be fixed since no physical barriers existed. The exact boundary line was fixed to intersect the Northeast and Northwest Freeways at points of relatively low traffic volumes and to include the arterial streets that parallel and intersect the freeways. The Spring Street-Baker Street Cordon Line surrounding the CBD was chosen as the southern limits of the study area since movement in the CBD is different than movement to or from the CBD (see Figures 1 and 2).

It is anticipated that the connecting link between the north freeways and south freeway will be completed in 1964. At present north freeway movement is restricted to a point near the CBD (Courtland Avenue, north of Baker Street). For this reason, present freeway data may not be representative of that in the future. However, current measures of traffic movement are used throughout the study. It is conceivable that travel time will decrease and volumes increase on the freeways and on some parallel streets due to this new facility. The changes taking place will not largely effect the results of this study.

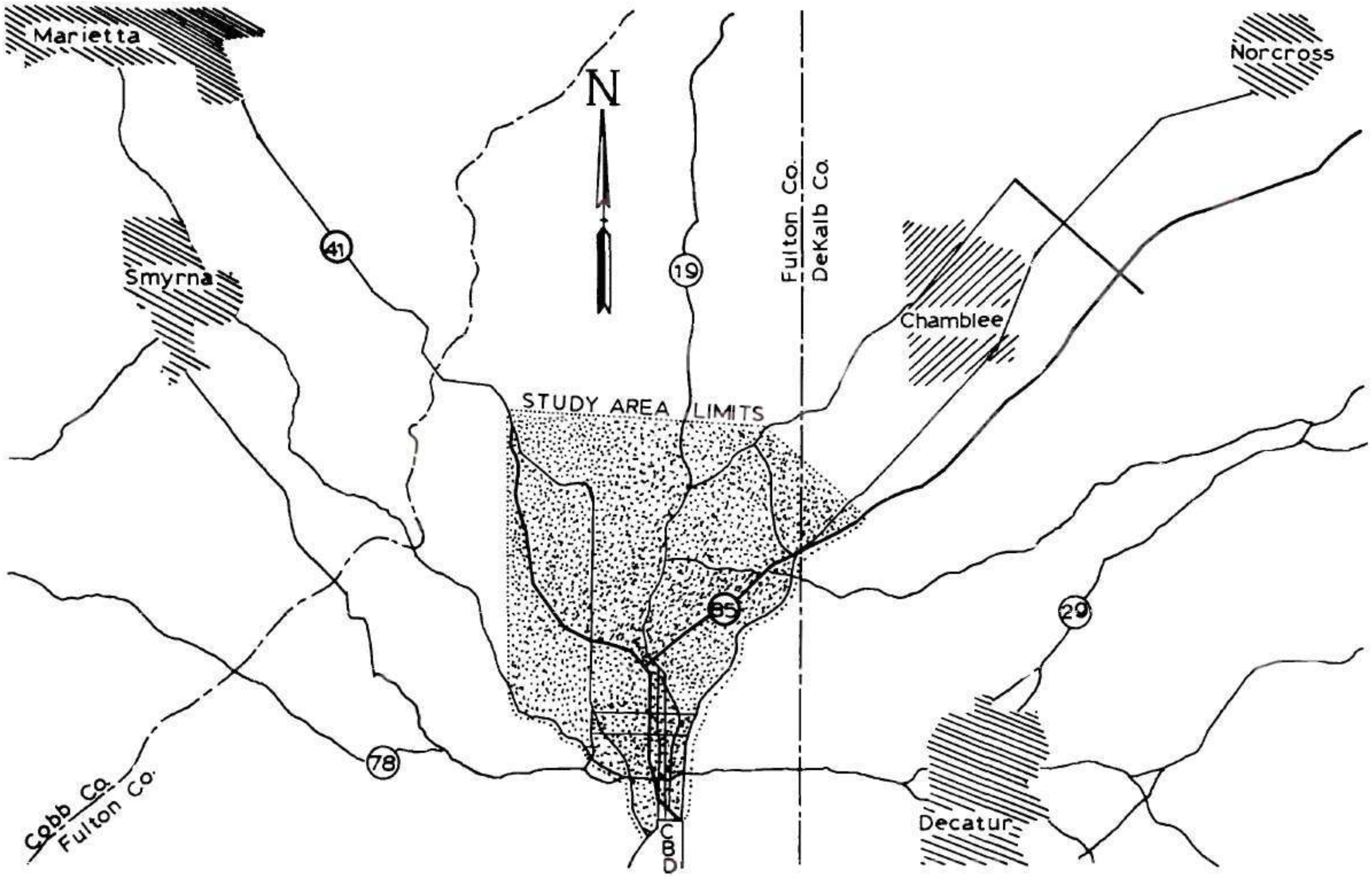


Figure 1. The Study Area

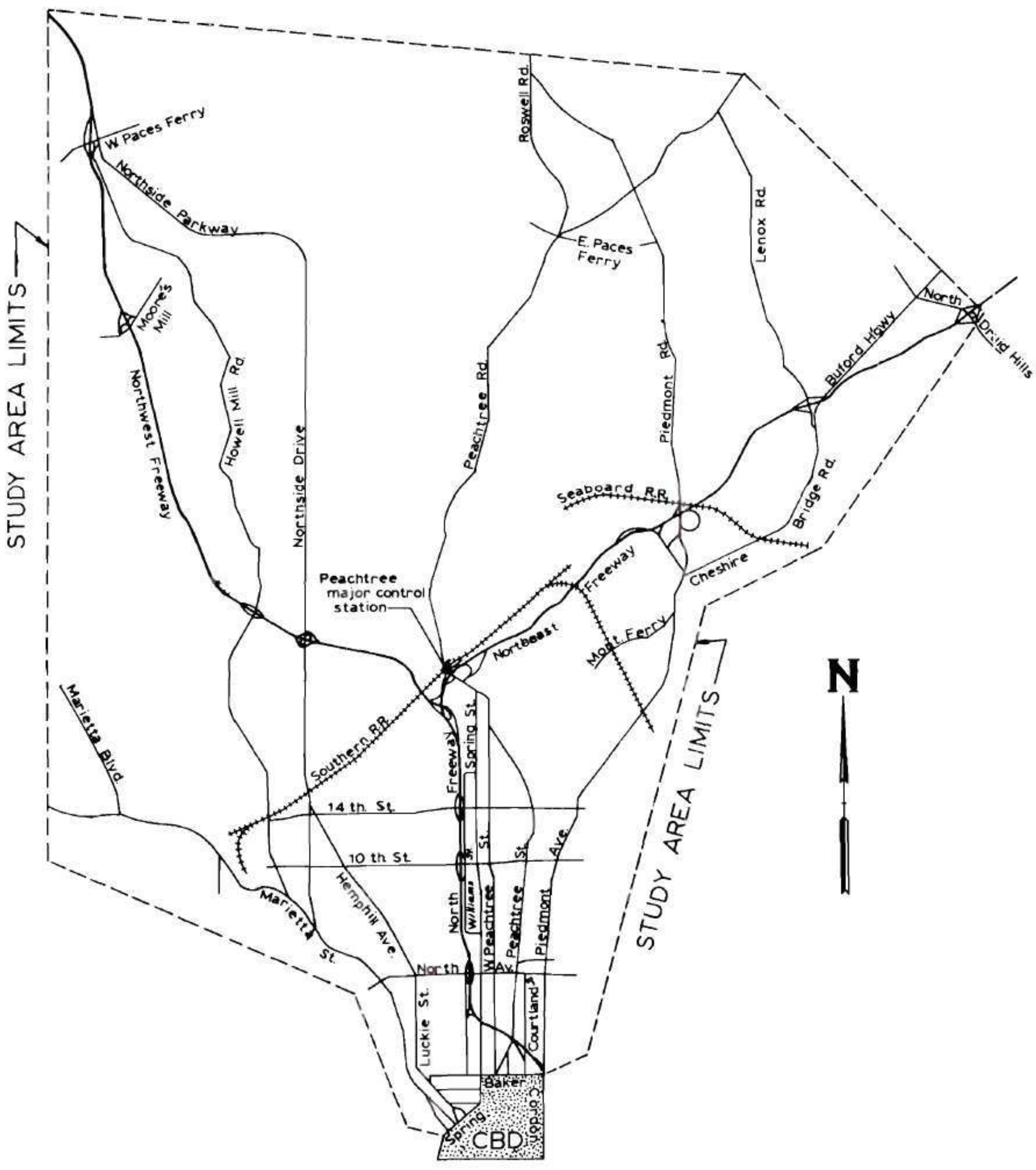


Figure 2. Freeway and Arterial Street System

The Inventories

"The data needs are dictated by the central purpose of the study." (23) The study was made for the purpose of determining methods to overcome the deficiencies in the movement of traffic and the capacities on the freeways and city streets system. Inventories of traffic volumes, facility capacities and travel times were taken to measure the ability of the existing system to move traffic. Since the freeway traffic flow reversal was considered only during peak hours, the inventories were limited mostly to these times. (The peak hours were determined from volume data to be the hours of 7 A.M. to 9 A.M. and 4 P.M. to 6 P.M. for flow towards and away from the CBD, respectively. In some cases volume counts were accumulated hourly and in other cases they were accumulated every fifteen minutes. The A.M. or P.M. peak hour was established by choosing the hour when the volume was the greatest, thus showing the worst existing conditions. Some estimations of peak-hour volumes had to be made where data was insufficient.) The screen line and cordon line 24-hour volumes are presented to show the total traffic entering and leaving the urban area and CBD, respectively, in relation to the peak hour traffic.

Due to time and available data limitations, land use and origin-destination surveys were not considered. The Georgia State Highway Department is in the process of computing these data from a recent Atlanta Area Transportation

Study.

The vehicle volumes, travel times and facility capacities, then, are the inventories that were taken. A comparison of facility capacity and use was made to point out the facilities in need of improvement. The inventories were made on the North, Northeast and Northwest Freeways and on the major arterials within control sections. The control sections terminate at the intersections of the major east-west and north-south arterials and the freeway interchanges. Minor stations were established to collect data for consistency in presentation.

Presentation and Analysis of Current Traffic Data

Traffic Volumes

The traffic volume data presented in this study was obtained from the Georgia State Highway Department and the Atlanta Traffic Engineering Department. With one exception, no major, minor, or key control counts were established since the volume data was collected at random with no established coverage procedure. The one exception is the Atlanta Control No. 3, Station No. 5052, as established by the Georgia State Highway Department during its Atlanta Area Transportation Study. This station is located on Peachtree Road, northwest of the Northeast Freeway. A continuous automatic volume count was taken there from April of 1960 to April of 1962. Manual counts were taken periodically to arrive at a mechanical count correction factor. The Georgia Highway Department calculated the factor such that mechanical counts would have to be increased 12.49 per cent to arrive at the correct volumes.

For the purposes of this study the aforementioned station shall be called the "Peachtree Major Control Station," as shown in Figure 2. As a major control station it was selected to sample representatively the traffic movement on the major street system. Volume data accumulated at this station in 1961 was used to obtain monthly, weekday expansion factors. These factors permit weekday counts made during any month to be adjusted to an average weekday count for that year (see Table 1). Weekday and weekly expansion factors were discounted since the volume counts were taken on so many different days.

At some stations peak-hour volumes were not counted. From both 24-hour and peak-hour volume counts taken at the Peachtree Major Control Station and on control sections of the freeway, approximations were made of the per cent that the peak-hour volume is of the total daily volume. The per cent directional split during the peak hours was also approximated (see Tables 8 and 9, Appendix). These figures were applied to 24-hour volume counts, where necessary, to determine the approximate peak-hour volumes. Volume counts were not obtainable at a few locations in the study area. An estimate was made of the traffic volume for each such

Table 1. Monthly Weekday Expansion Factors* Determined from 1961 Traffic Volumes at Peachtree Major Control Station

Month	Average Weekday Volume	Adjusted Weekday Volume**	Factor
January	28,564	32,132	0.952
February	28,872	32,478	0.962
March	28,797	32,394	0.960
April	29,660	33,365	0.988
May	28,914	32,525	0.963
June	30,010	33,758	1.000
July	28,374	31,918	0.945
August	32,350	36,390	1.078
September	32,298	36,332	1.076
October	30,352	34,143	1.011
November	31,204	35,101	1.040
December	30,725	34,562	1.024
Average		33,758	1.000

*Dividing a representative volume count for a given month by the appropriate factor from this table will yield the annual average weekday traffic.

**Machine count adjusted upward 12.49 per cent.

Source: Georgia State Highway Department.

location based on per cent turning movements and volumes at nearby intersections.

The peak-hour volume data was adjusted by the monthly expansion factors to the 1961 average weekday peak-hour traffic (see Table 10, Appendix). The A.M. and P.M. peak-hour data are represented by Figures 3 and 4, respectively. Figure 5 shows a typical hourly variation in traffic flow. The knowledge of this cyclical variation in traffic flow was useful in determining the peak hours and critical periods of traffic flow.

Traffic volumes in the minor direction of flow during peak hours were also recorded. These were used in the considerations of traffic flow reversal on the freeways during peak hours. As shown in Table 9 of the Appendix, the volume of traffic in the minor direction of flow on the freeways is approximately 35 and 40 per cent of the two-way volume for the A.M. and P.M. peak hours, respectively. On the arterial streets, the volume in the minor direction of flow during the peak hour is approximately 40 per cent of the two-way volume (see Table 8, Appendix).

In addition to peak-hour volume counts, 24-hour counts were made at two locations. One of these was the Central Business District Cordon Line as established by the Georgia State Highway Department. The CBD, in particular Baker Street and Spring Street, is the southern terminus of the study area (see Figure 2). The 24-hour inbound and out-

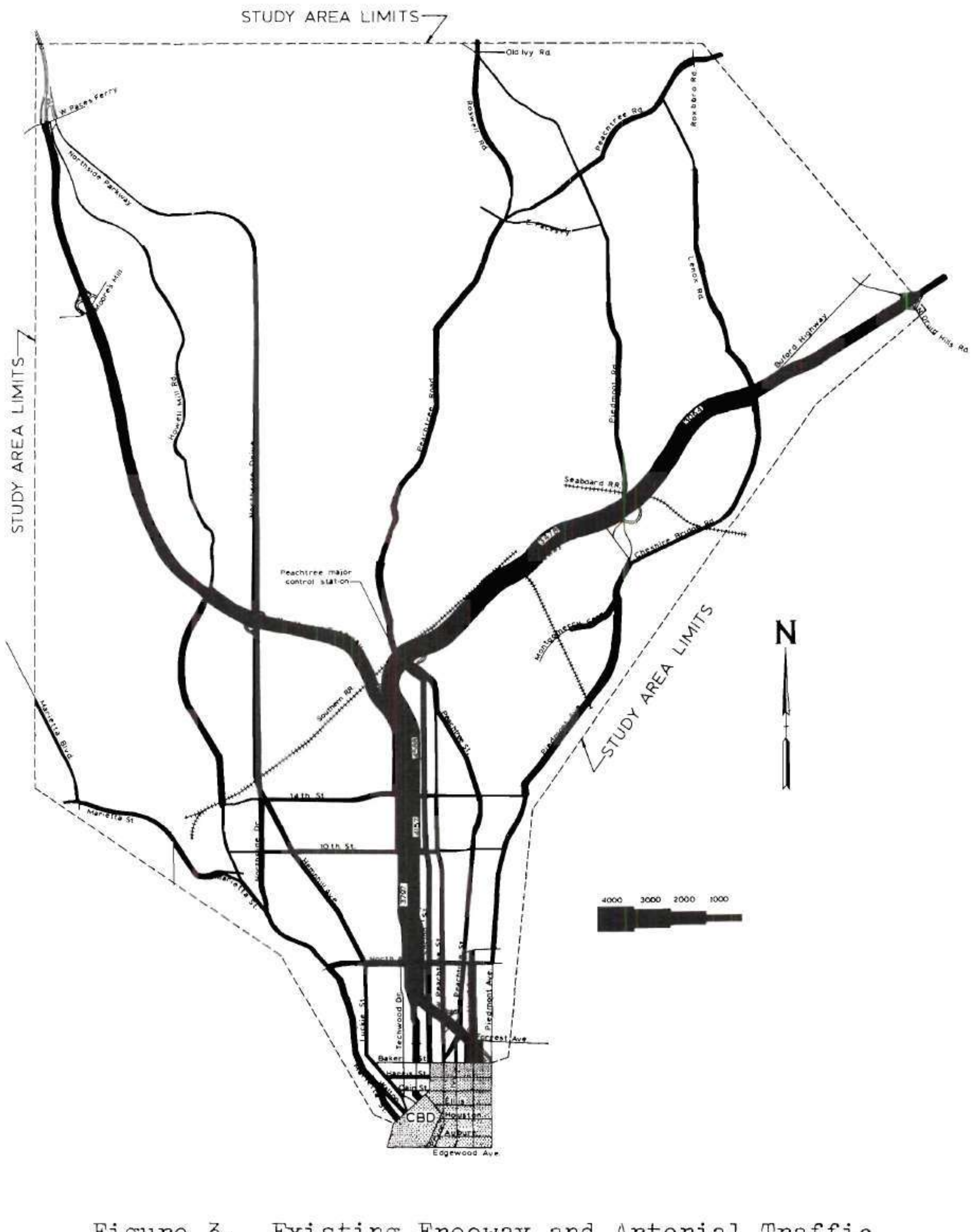


Figure 3. Existing Freeway and Arterial Traffic Flow--A.M. Peak Hour

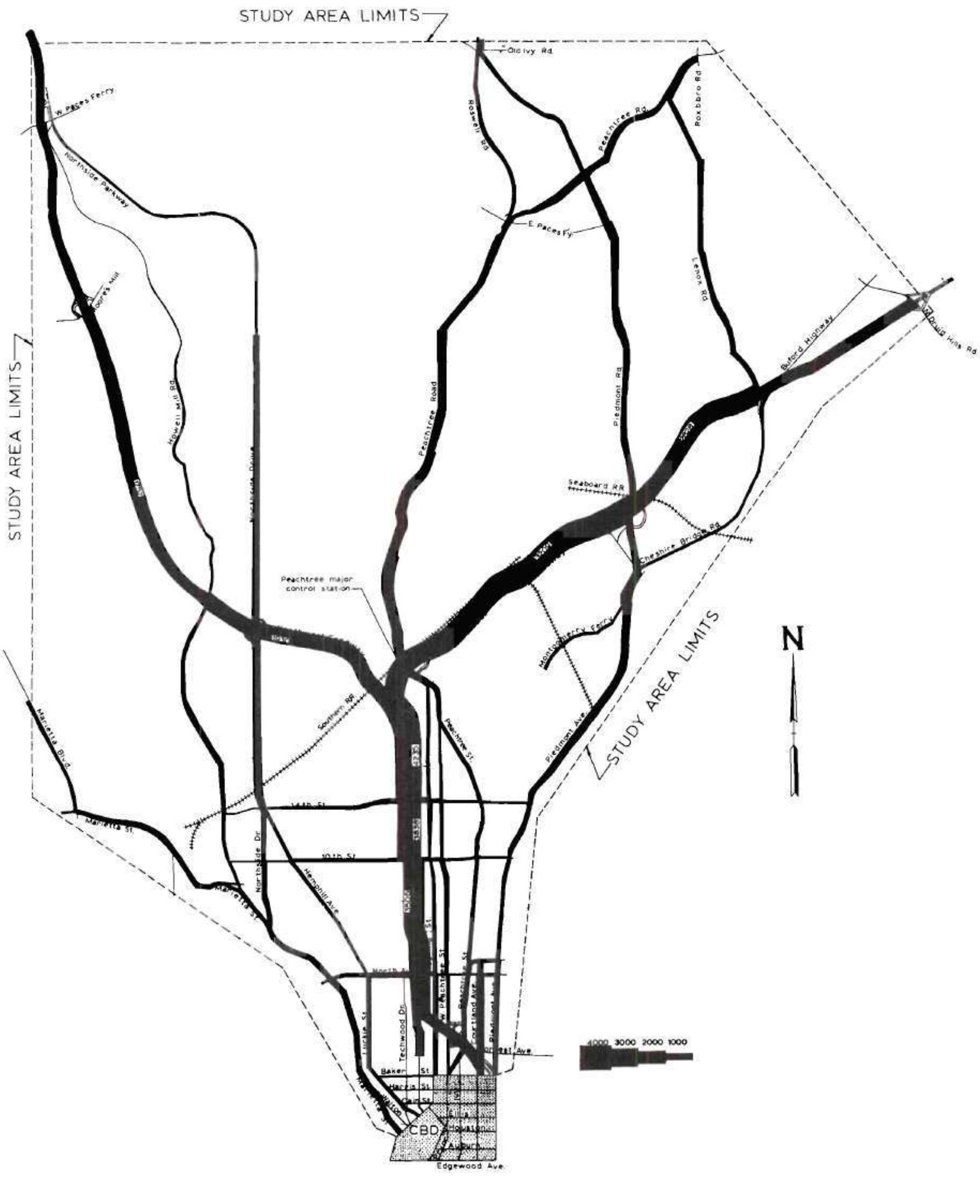


Figure 4. Existing Freeway and Arterial Traffic Flow--P.M. Peak Hour

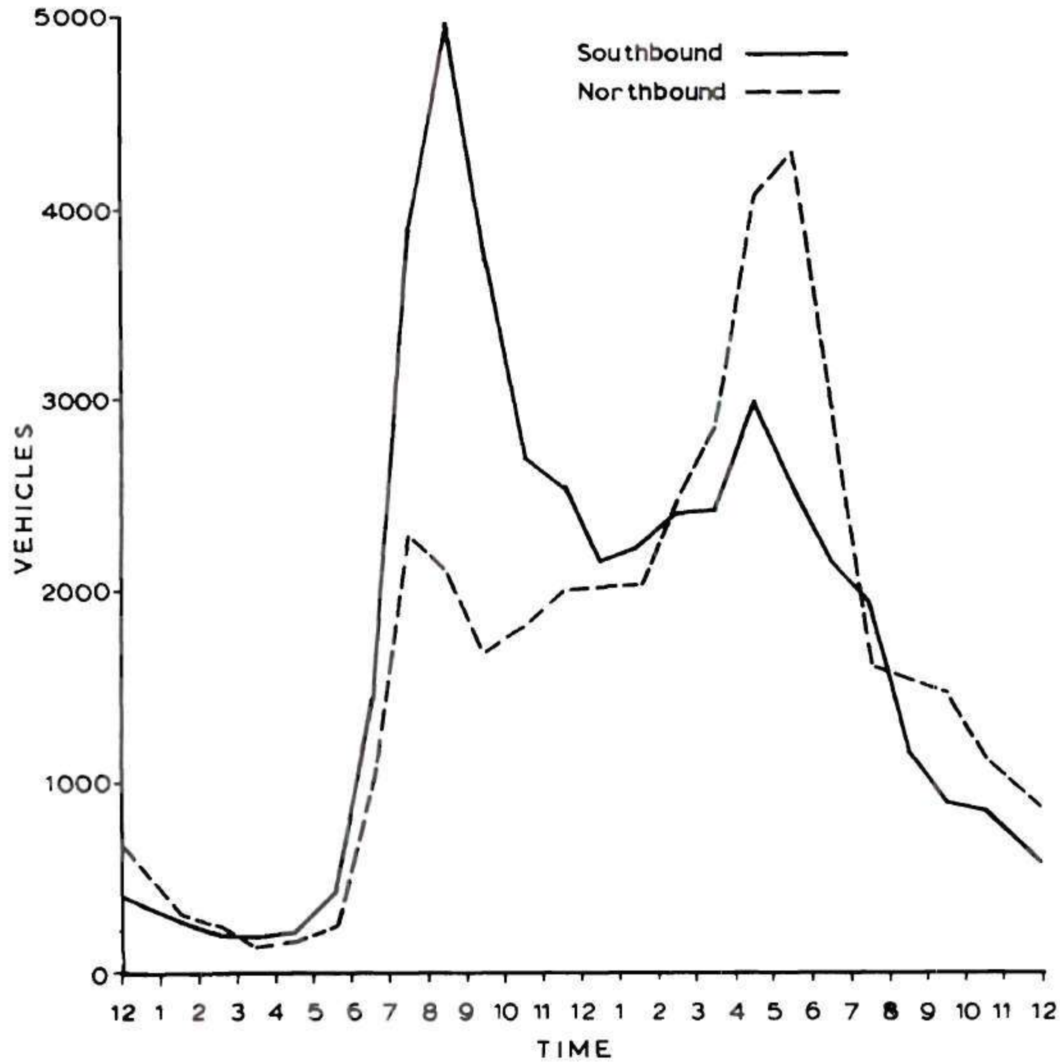


Figure 5. Hourly Variation in Traffic Volume on a Typical Weekday (North of Fourteenth Street on the Freeway)

bound volumes of traffic crossing the cordon line were assembled to show the total number of vehicles entering and leaving the CBD through the study area on the average weekday. The inbound and outbound peak volumes were also determined and are shown in Figure 6. Of the 88,235 vehicles that entered the CBD from the study area in 24 hours, 14,416 or 16.34 per cent entered during the A.M. peak hours. Of the 72,613 vehicles that entered the study area from the CBD in 24 hours, 11,243 or 15.48 per cent entered during the P.M. peak hours (see Table 11, Appendix).

The other location where 24-hour volume counts were made was the Southern Railroad Screen Line as established by the Atlanta Traffic Engineering Department (see Figure 2). The 24-hour inbound and outbound volumes of traffic crossing the screen line were assembled to show the total number of vehicles entering and leaving the Atlanta urban area on the average weekday. The inbound and outbound peak volumes were also determined and are shown in Figure 7. The screen line was also used to locate minor stations where peak volume counts were taken. Of the 101,797 vehicles that entered the urban area in 24 hours, 22,339 or 21.94 per cent entered during the A.M. peak hours. Of the 102,483 vehicles that left the Atlanta urban area in 24 hours, 22,120 or 21.58 per cent left during the P.M. peak hours (see Table 12, Appendix).

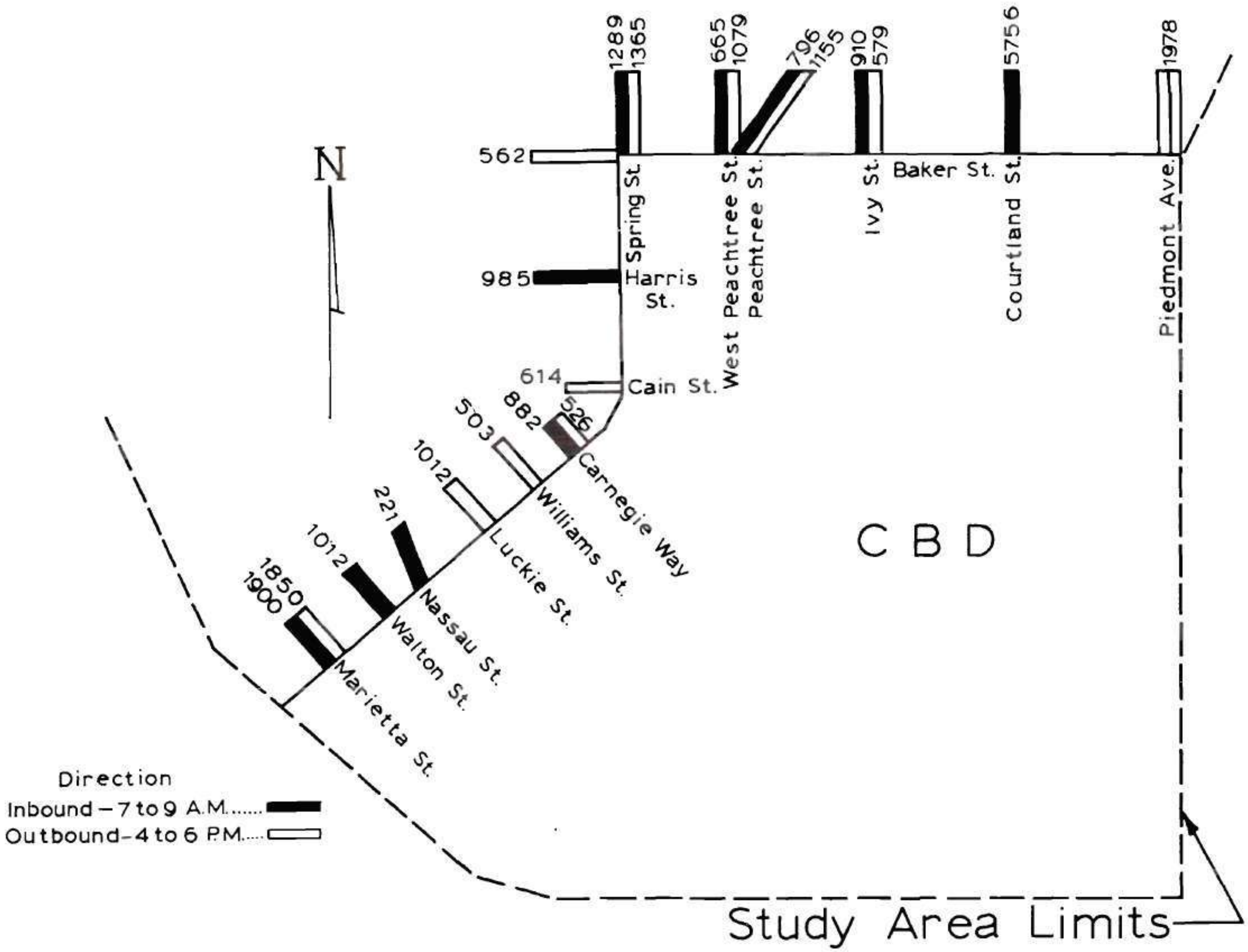


Figure 6. Vehicles Entering and Leaving the Central Business District at Each Cordon Station

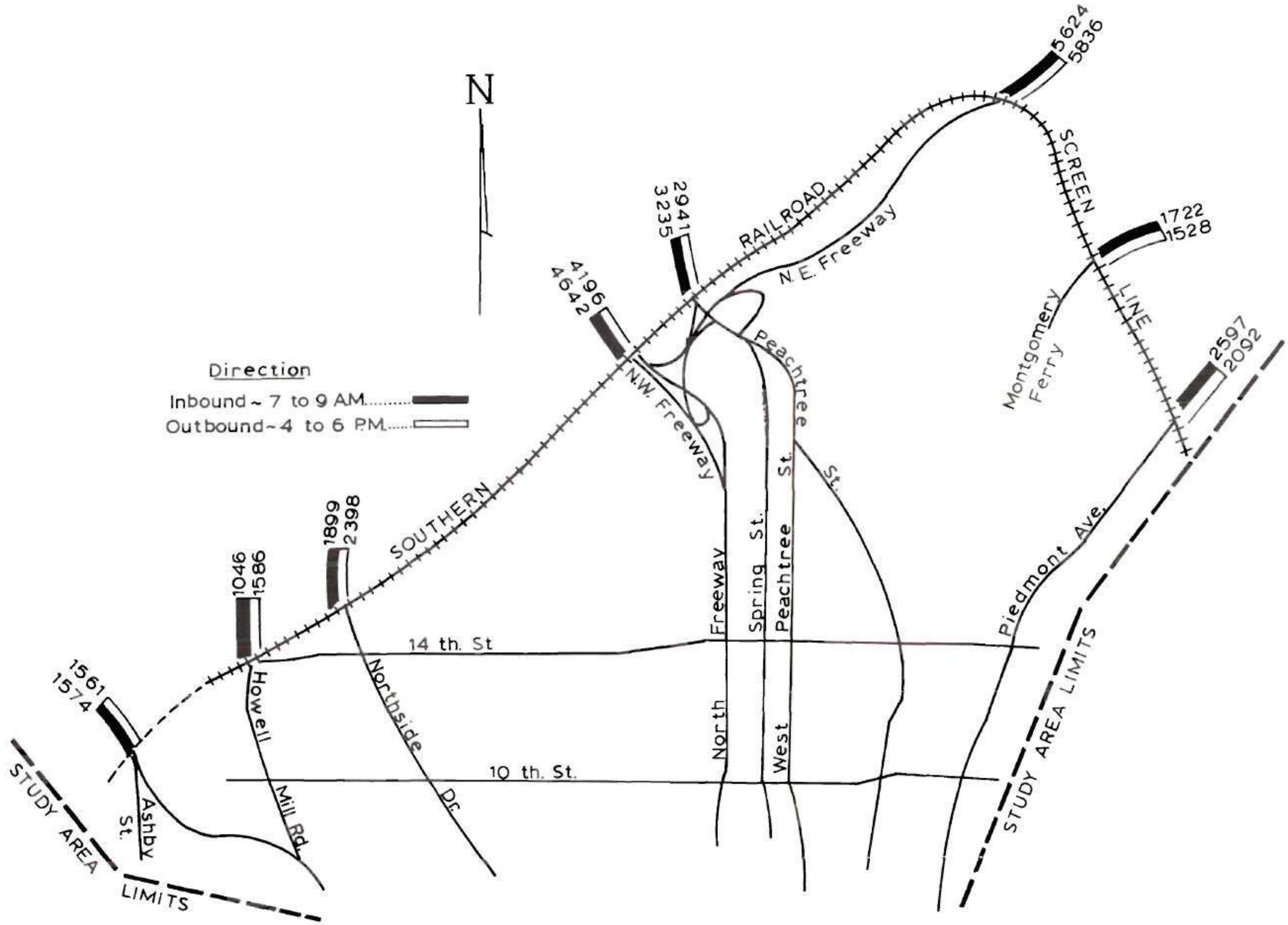


Figure 7. Vehicles Entering and Leaving the Urban Area at Each Screen Line Crossing

Travel Time

Reduced travel time and congestion are usually the primary objectives of any transportation improvement plan. The reason an excessive amount of congestion is such a disadvantage is the increased travel time connected with it. The relative level of service of the different segments of the arterial streets and freeways can be measured by examining the travel times on these segments. (24)

Average attainable speeds and travel times were determined for each control section in the study area during the A.M. and P.M. peak hours. The majority of the data was obtained from a study of ramp closings made by Project B-190 of the Georgia Tech Engineering Experiment Station and accumulated before any ramps were closed. (25) Further speed and delay runs and some estimations were made to complement this data (see Table 13, Appendix).

The time required to travel from points within the study area (excluding east-west streets) to the CBD during the morning peak hours is shown in Figures 8 and 9. The CBD can be reached, in equal time, from any point along one of the contour lines. The figures may be superimposed on one another to examine the travel time on the freeways in relation to that on the arterials. The time required to travel from the CBD (excluding east-west streets) to any point in the study area during the evening peak hour is shown in Figures 10 and 11. The contour lines represent points that can be reached, in

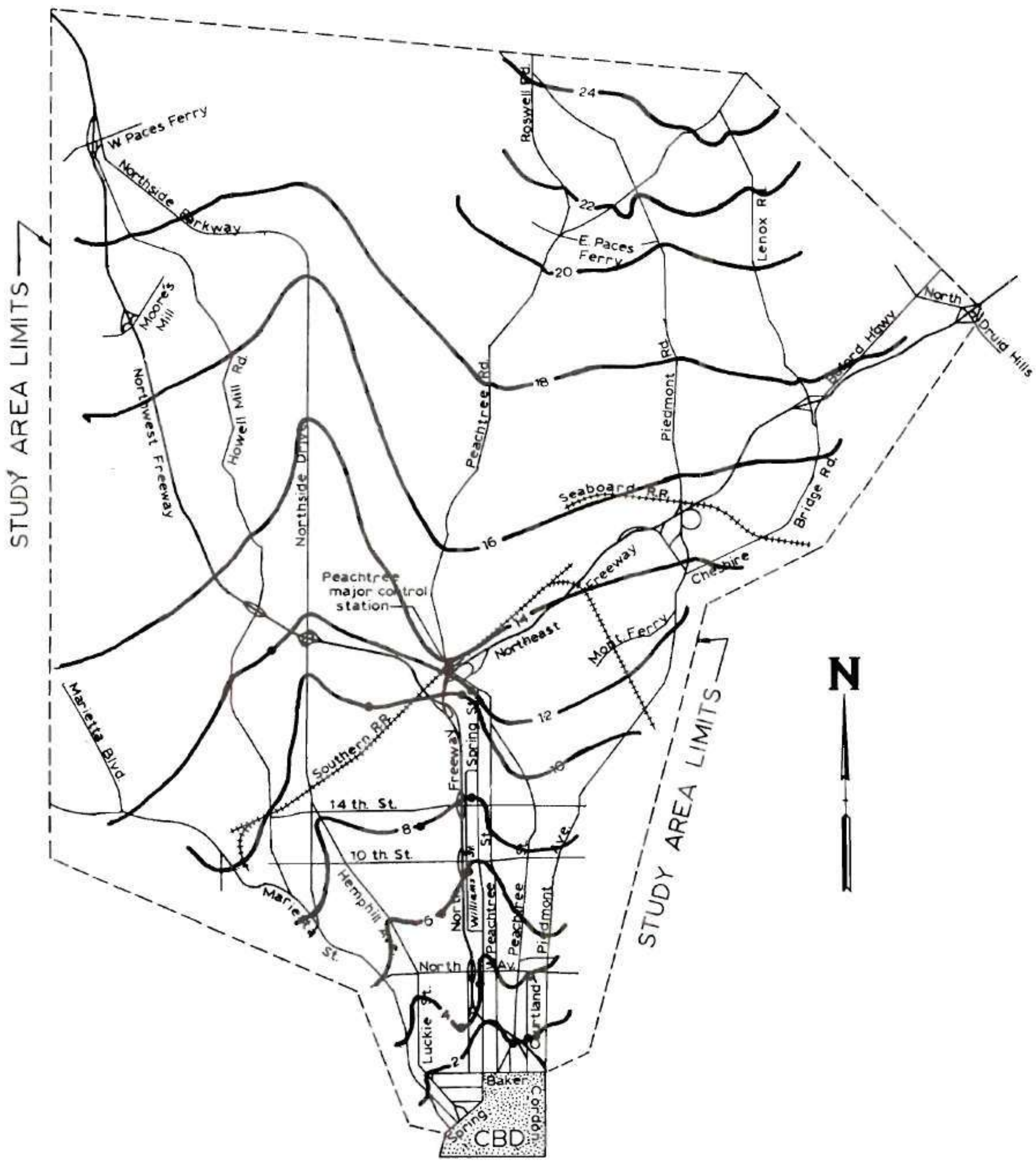


Figure 8. Time Contour Map of A.M. Peak Hour Travel Time Toward the CBD--Arterial Streets

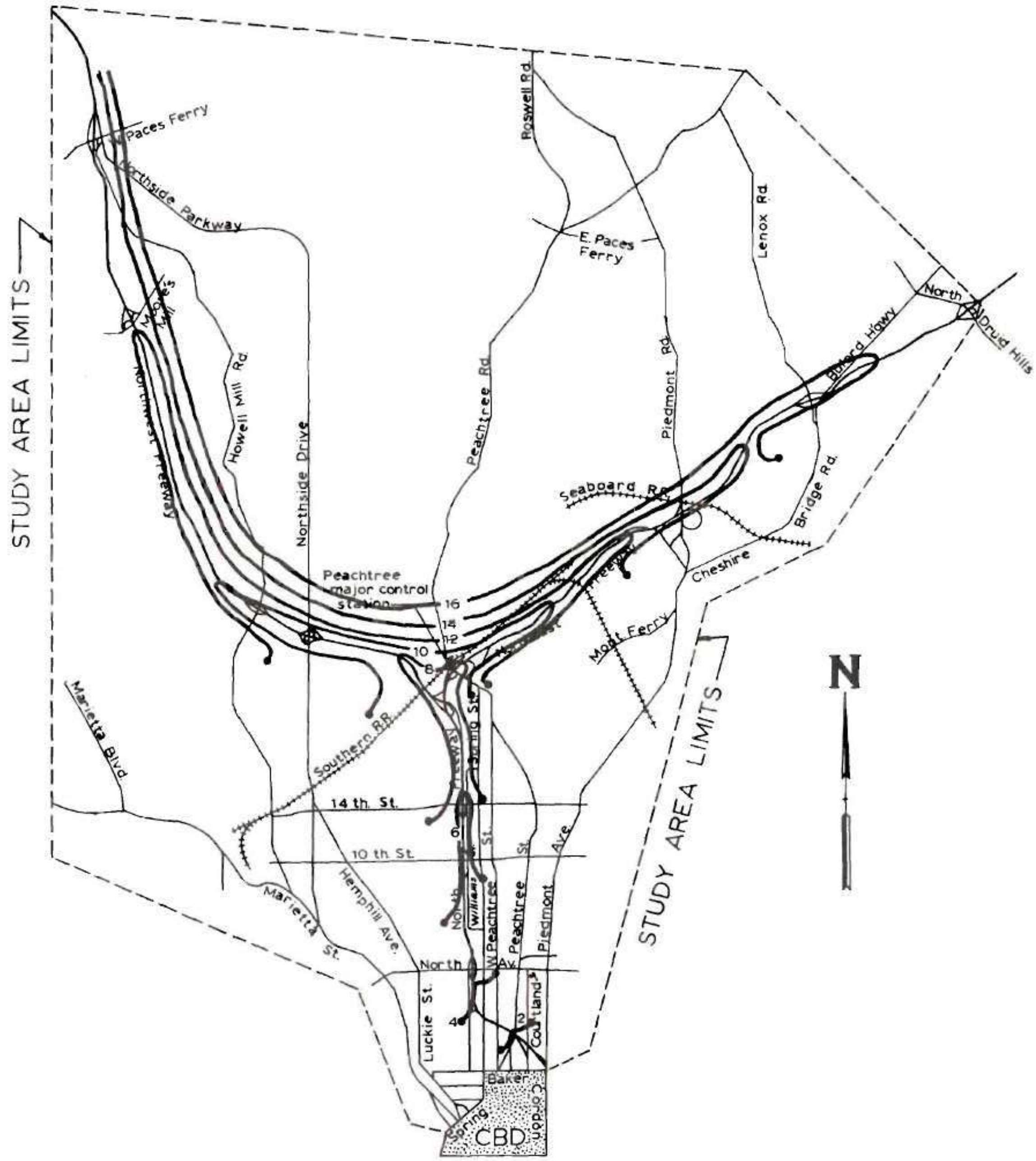


Figure 9. Time Contour Map of A.M. Peak Hour Travel Time Toward the CBD--Freeways

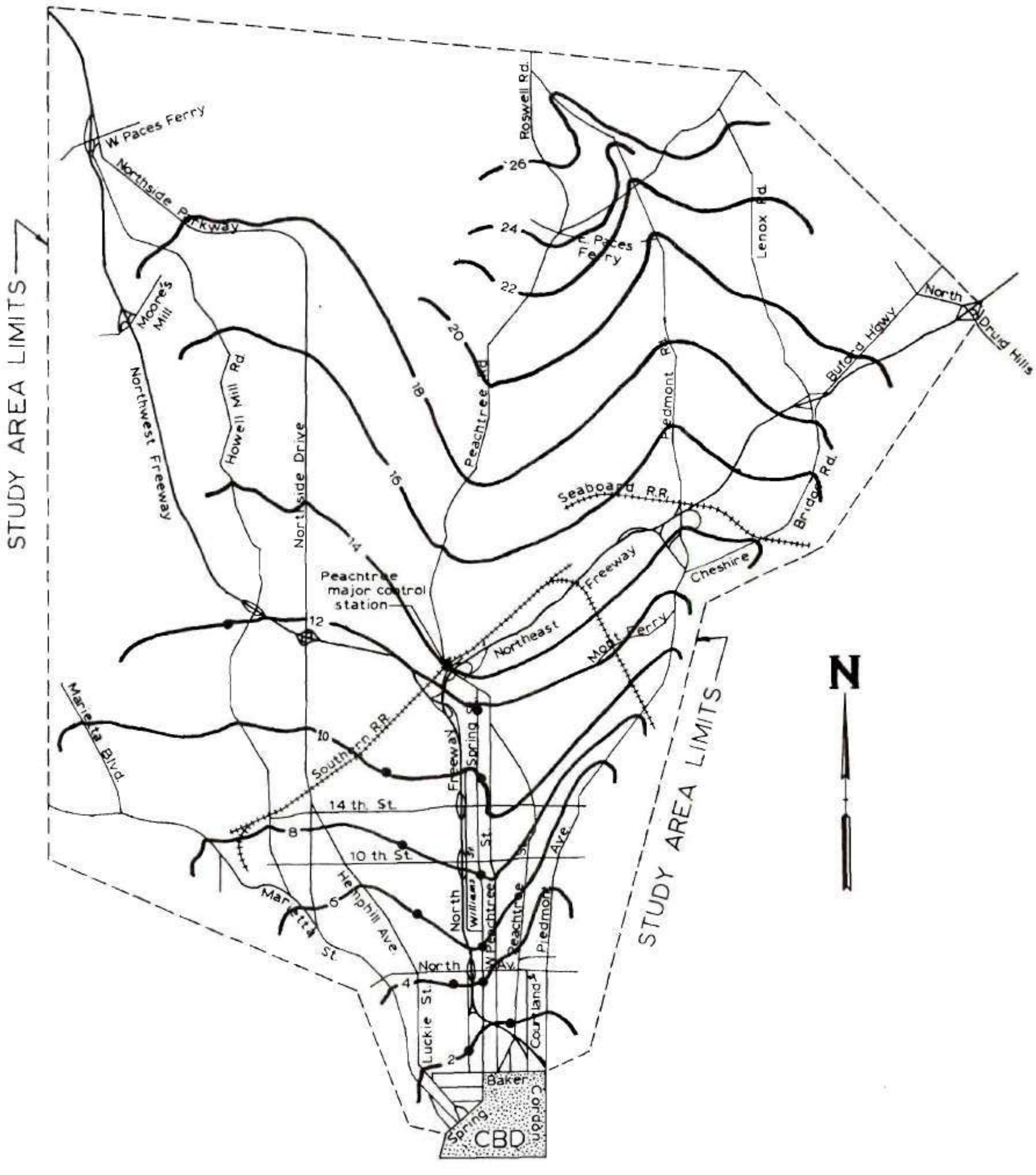


Figure 10. Time Contour Map of P.M. Peak Hour Travel Away from the CBD--Arterial Streets

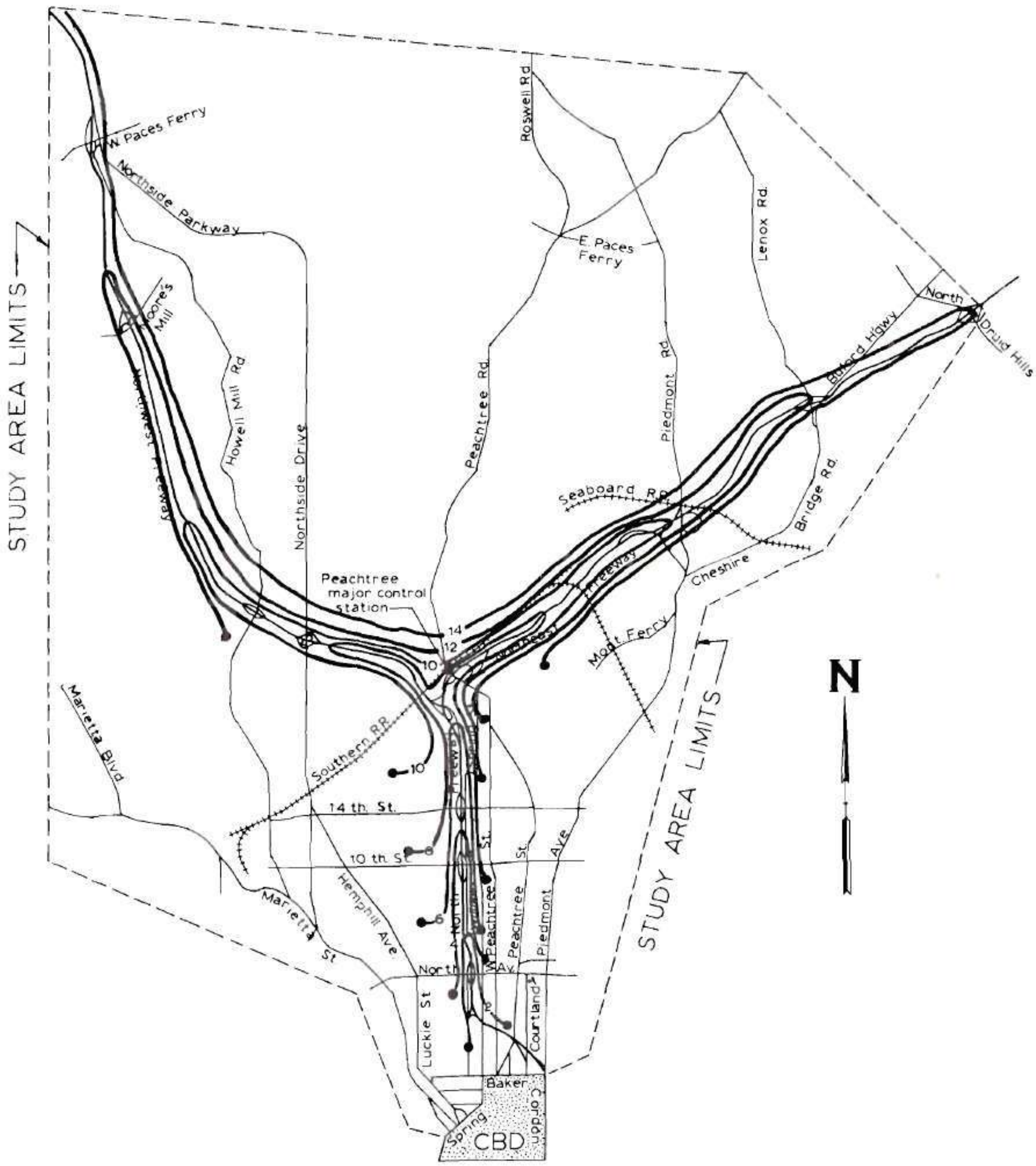


Figure 11. Time Contour Map of P.M. Peak Hour Travel Time Away from the CBD--Freeways

equal time, from the CBD. The figures may be superimposed on one another to examine the travel time on the freeways in relation to that on the arterials.

Figures 12 and 13 depict the time required to travel on the major east-west arterials in the urban area. The time required to travel from the western side to the eastern side of the study area during the morning peak hour is shown in Figure 12. Likewise, Figure 13 shows the time required to travel from the eastern side to the western side of the study area during the evening peak hour.

In Figures 8 through 13 the crowded contour lines represent segments where travel is slow and congested. The most congested segments are on North Avenue and Fourteenth Street in the P.M. peak hour from Piedmont Avenue to the North Freeway where over-all travel speed is about 6.5 mph and 9.0 mph, respectively.

Figure 14 shows the average speed and delay in traveling typical north-south routes in the study area. The average speeds of 13.1 mph and 27.5 mph on a major arterial and the freeway, respectively, are well below the Suggested Standard Peak Hour Speeds of 25 mph and 35 mph. (26) On the freeways, travel times vary for different lanes and destinations (northwest or northeast leg) of travel. They were averaged for ease in presentation on the contour maps. The travel time on the North Freeway to the Northwest Freeway was greater than that to the Northeast Freeway due to main-

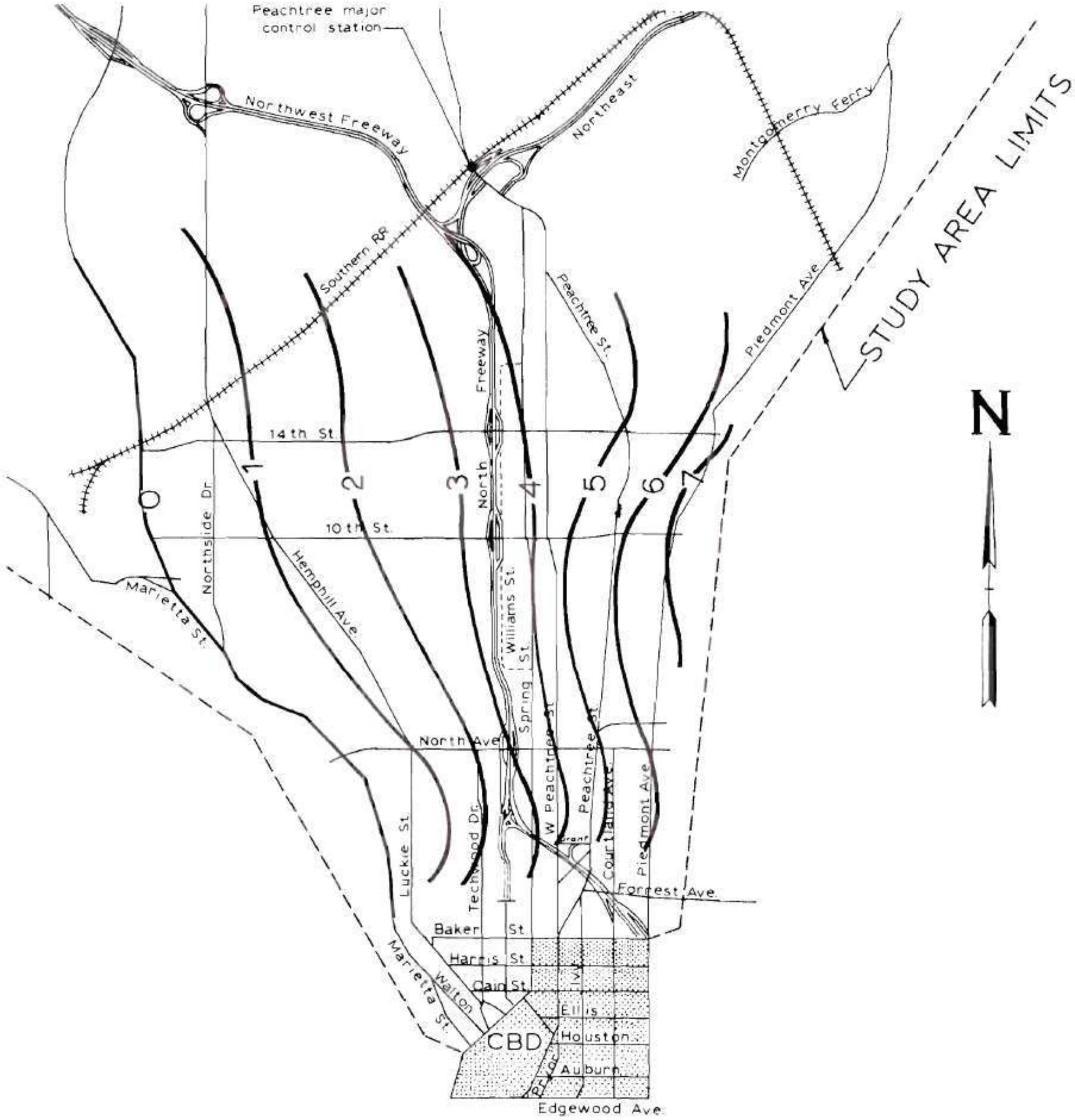


Figure 12. Time Contour Map of A.M. Peak Hour Travel Time in an Easterly Direction

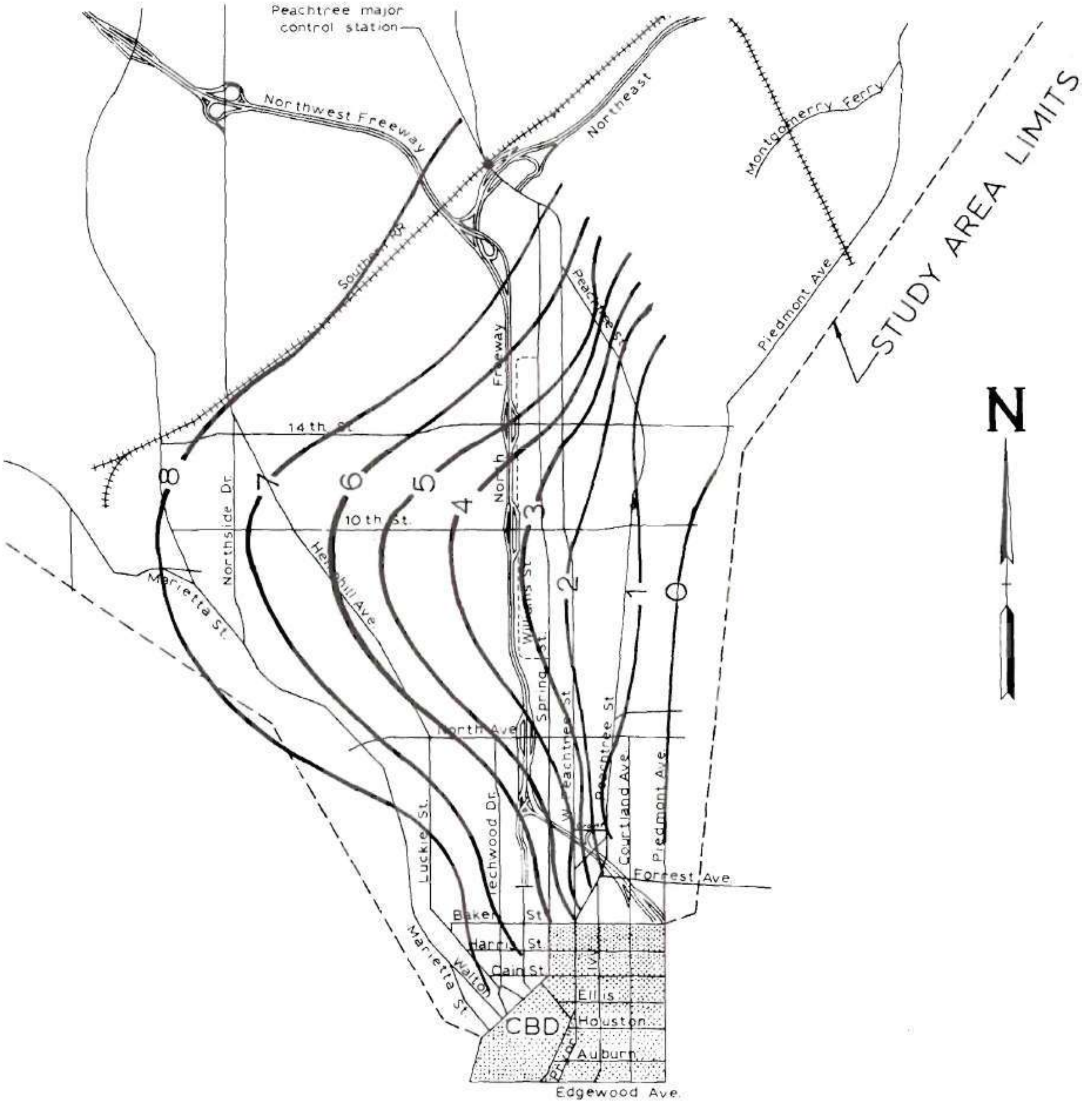


Figure 13. Time Contour Map of P.M. Peak Hour Travel Time in a Westerly Direction

Time in Motion Time Delayed

Running Speed of 19.3 MPH Required
to Average 13.1 MPH

Per Cent of Total Delay

Intersection Delay Midblock Delay

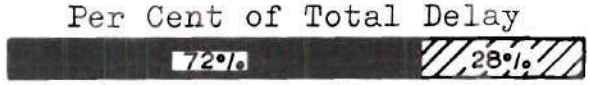
Intermediate Area--N.B.*

CBD to Freeway

Time in Motion Time Delayed

Running Speed of 28.4 MPH Required
to Average 27.5 MPH

Per Cent of Total Delay



Exit and Entrance Delay Delay on Freeway

Freeway--S.B.**

(Moore's Mill Rd. or North Druid Hills Rd. to CBD)

*Travel Time in the Opposite Direction is Longer

**Travel Time in the Opposite Direction is Shorter

Figure 14. Average Peak Hour Speed and Delay in Traveling a Typical North-South Route in the Study Area

taining the proper lane disposition.

Capacity

To determine the deficiencies in the quality and the needs for improvement of the arterial street and the freeway system, a quantitative measure of the capacity of the existing facilities was essential. To relate the capacities to the current traffic volume, the peak hour was chosen as the unit of time.

The capacity measures reflect the movement of vehicles at intersection approaches on each control section in the study area. From data supplied by the Atlanta Traffic Engineering Department, the average widths of control sections and the average per cent of traffic signal green times were calculated for the arterial streets (see Table 14, Appendix). With the exception of Fourteenth Street and Piedmont Avenue, the arterial streets had an average of 50 per cent green time. Fourteenth Street and Piedmont Avenue had 60 per cent and 55 per cent green times, respectively, in the major direction of progression.

In order to provide some control over the frictions reflecting the flow of traffic, the following operating assumptions were made for all streets:

1. No separate left or right turn lanes
2. Ten per cent left turns
3. Ten per cent right turns
4. Ten per cent commercial vehicles

5. Near side bus stops

6. With the exception of arterial streets at the CBD, streets in an outlying business and intermediate residential area.

In general, parking was prohibited on major arterials, however, where it was permitted it was taken into account. Capacities used in this study are shown in Table 2.

Capacity and Use Compared

Figure 15 shows the arterial street and the freeway segments that carry traffic volumes in excess of their practical capacities. In some cases, the capacity is exceeded in only one direction of traffic movement. Also, the section of the North Freeway, northbound lanes, north of Fourteenth Street to the Northeast-Northwest Freeway junction is considered to be a weaving section. As a weaving section, this segment of the freeway has a capacity below that of other three-lane segments.

To permit efficient and uncongested movement of traffic on the overcrowded segments of the arterial streets, some improvements must be made to the city street system to complement those that will be proposed for the freeway.

Detailed Analysis of Freeway and Interchange Volumes and Capacities

The traffic volumes and capacities on the freeway system must be further analyzed before any methods of peak

Table 2. One-Direction Practical Capacities of Freeways and of Arterial Streets at Intersection Approaches in Vehicles Per Hour of Green Time.

Street Type	Per Cent Green Signal Time	Approach Width in Feet (Curb to Center Line)								
		20	22	24	26	30	33	40	44	50
Arterial*										
Fringe CBD (No Parking)	50	740	780			1,000	1,070	1,270	1,400	
Outlying Business and Intermediate Residential (No Parking)	50	720	800	900		1,220	1,400	1,920		
	55	760	870			1,340	1,530	2,100		
	60	860	960			1,460	1,690	2,300		
One-Way Intermediate (No Parking)	55	1,230	1,450			2,200	2,420	2,900	3,120	3,500
Fringe and Outlying Business and Intermediate Residential (With Parking)	50	520	580	630	700	800	910	1,150	1,310	
	60	630		770	840					
Freeway										
Average for all Areas		1,500 Vehicles Per Hour Average Per 12-Foot Lane for Direction of Heavier Flow								

*Average Lane Widths were computed for each segment; in some cases certain widths were not applicable to all streets.

Source: Highway Capacity Manual (1950) and Revised Charts (2-6-59), Bureau of Public Roads.

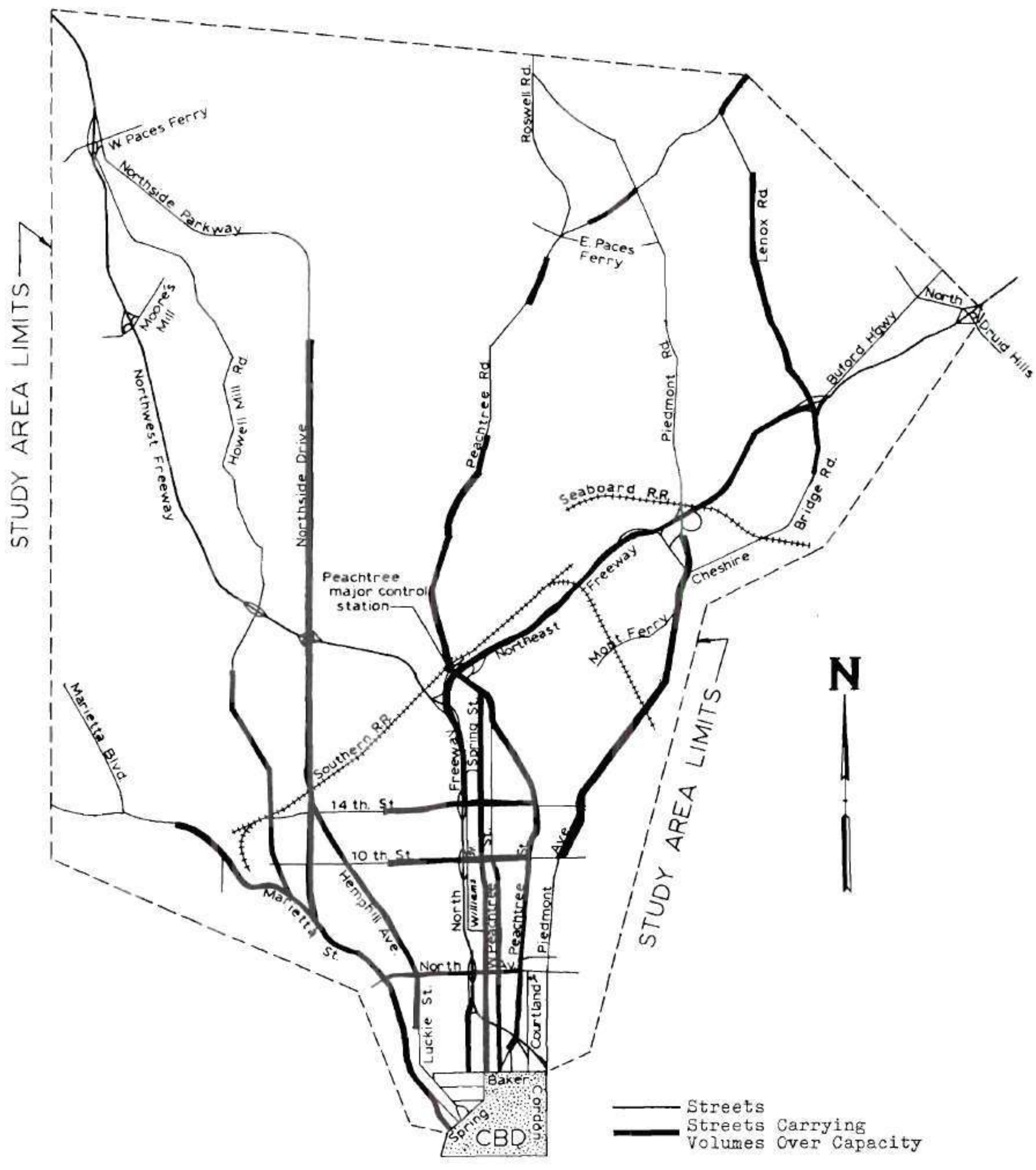


Figure 15. Freeway Sections and Arterial Streets Carrying Traffic Volumes Greater Than Their Capacity

hour traffic flow reversal are proposed. This analysis will give a clearer picture of the present conditions and lay the foundation for establishing methods of lane reversal. It will concurrently eliminate unnecessary work by pointing out conditions that make certain methods infeasible at the start. In the analysis, the traffic volumes in the minor and major direction of flow on the freeway, on the city street and freeway interchanges, and on the Northeast-Northwest Freeway Junction are considered in relation to the respective capacities. The arterial streets that are affected by the proposed methods of reversal are discussed in the next chapter.

The Freeways

Periodic congestion and volumes in excess of the capacities on certain sections of the freeway have been determined in the previous section. In the morning peak hours of 7 A.M. to 9 A.M. and in the evening peak hours of 4 P.M. to 6 P.M. the North Freeway carries volumes in the major direction of flow in excess of the capacities on the Williams Street on and off ramps and on the section north of Fourteenth Street. The Northeast Freeway carries volumes in the major direction of flow in excess of the capacity from the Northeast-Northwest Freeway Junction to the Cheshire Bridge Road Interchange in both the morning and evening peak hours. The minor direction of peak hour traffic flow is provided with sufficient capacity on both of these freeways. The Northwest Freeway provides adequate capacity in both directions at all hours of the day.

The North Freeway is a six-lane facility and the Northeast and Northwest Freeways are four-lane facilities. The availability of lanes for traffic flow reversal was computed from formulae and methods that utilize the existing volumes and capacities. (27) It was determined that one lane is available for reversal on the North Freeway and no lanes are available on the Northeast and Northwest Freeways. However, methods of reversal are discussed for all of these facilities. The traffic volume in the minor direction of flow is discussed in more detail together with the Northeast-Northwest Freeway Junction.

The Interchanges

The volume of traffic entering and leaving the freeways at the interchanges and the traffic volume on the Brookwood Interchange can be determined from the data shown in Table 3. The data in this table and in the following discussion were the data used in the preparation of the volume flow maps, approximated to the nearest 25 vehicles per hour.

In the morning peak hour, beginning at the upper limits of the study area, the volumes on successive sections of the Northwest and Northeast Freeways increase to Northside Drive and Peachtree Road, respectively. Relatively few southbound vehicles exit from the freeways prior to these interchanges. Northside Drive is the only arterial

Table 3. Freeway Traffic Volumes

	AM Peak Hour Vehicles Per Hour		PM Peak Hour Vehicles Per Hour	
	Major Flow	Minor Flow	Major Flow	Minor Flow
Northeast Freeway				
North of N. Druid Hills Rd.	1,450	675	1,350	850
South of N. Druid Hills Rd.	2,200	1,175	2,025	1,350
South of Cheshire Bridge Rd.	3,050	1,650	2,825	1,900
South of Piedmont Rd.	3,475	1,875	3,200	2,150
South of Peachtree Rd.	3,775	2,625	3,325	
Continue to Northwest Freeway	450			475
Continue to North Freeway	3,325			2,075
Come from Northwest Freeway		825	550	
Come from North Freeway		1,800	2,775	
Northwest Freeway				
North of West Paces Ferry Rd.	1,575	850	1,400	975
South of West Paces Ferry Rd.	1,825	975	1,625	1,125
South of Moore's Mill Rd.	1,900	1,000	1,725	1,175
South of Howell Mill Rd.	2,100	1,125	1,925	1,300
North of Brookwood Interchange	2,075	1,125	1,925	1,800
Continue to Northeast Freeway	825			550
Continue to North Freeway	1,250			750
Come from Northeast Freeway		450	475	
Come from North Freeway		675	1,450	

Table 3. Freeway Traffic Volumes (Continued)

	AM Peak Hour Vehicles Per Hour		PM Peak Hour Vehicles Per Hour	
	Major Flow	Minor Flow	Major Flow	Minor Flow
North Freeway				
North of Fourteenth Street	4,575	2,475	4,225	2,825
South of Fourteenth Street	4,150	2,250	3,850	2,550
South of Tenth Street	3,800	2,050	3,500	2,350
South of North Avenue	3,675		3,375	
To/From Williams Street	1,900		1,750	
To/From Courtland/Piedmont Ave.	1,775		1,625	

street serving the Northwest Freeway that carries traffic volumes in excess of the capacity in the vicinity of the freeway. The excess volume amounts to 500 vehicles per hour in the major direction of flow. The minor direction of flow is provided with sufficient capacity.

The capacities of North Druid Hills Road, Cheshire Bridge Road, Piedmont Road, and Peachtree Street in the vicinity of the Northeast Freeway are exceeded by 150, 200, 300, and 400 vehicles per hour, respectively, in the major direction of flow. Cheshire Bridge Road and Piedmont Road are the only arterials serving the Northeast Freeway that provide excess capacity to the minor direction of flow. This amounts to 225 and 200 vehicles per hour, respectively.

The traffic volumes in the minor and major directions of flow in the vicinity of the North Freeway on Fourteenth Street, Tenth Street and North Avenue are approximately the same, i.e., for each particular street the minor and major flow volumes are about the same. The capacities of these arterials are exceeded by some 100, 200, and 300 vehicles per hour, respectively, in both directions of flow.

The traffic volume on the freeways during the evening peak hour is less than the morning peak hour volume. However, the trend is about the same in reverse. Relatively few northbound vehicles exit from the freeways prior to the Northside Drive and Peachtree Street interchanges. Again, the minor and major directions of traffic flow on North

Avenue, Tenth Street, and Fourteenth Street are approximately the same. The capacities of the arterials in the vicinity of the freeway are exceeded by 300, 200, and 250 vehicles per hour, respectively.

The capacities of Piedmont Road, Cheshire Bridge Road, and North Druid Hills Road in the vicinity of the freeway are exceeded by 300, 300, and 200 vehicles per hour, respectively, in the major direction of flow. Excess capacity of about 100 vehicles per hour in the minor direction of flow is provided on Piedmont Road and Cheshire Bridge Road, only.

Northside Drive is the only arterial serving the Northwest Freeway that carries volumes in excess of the capacity. South of the freeway this excess volume is over 150 vehicles per hour while north of the freeway it is 700. The minor direction of flow is provided with excess capacity.

In review, it can be seen that both the minor and major direction of traffic flow create congestion on North Avenue, Tenth Street and Fourteenth Street at the North Freeway Interchanges in the morning and evening peak hour. Peachtree Street, Piedmont Road, Cheshire Bridge Road, and North Druid Hills Road are congested only in the major direction of flow at the Northeast Freeway Interchanges. Northside Drive is likewise congested near the Northwest Freeway.

The nature of the Brookwood Interchange warrants further analysis of the volumes on it. This analysis is a prerequisite to establishing methods of traffic flow reversal through the interchange. Inspection of Table 3 shows that there is a large movement of vehicles in the morning and evening peak hours traveling from the major directions of flow and going into the minor directions of flow on the Brookwood Interchange. The same is true of vehicles traveling from the minor directions of flow and going into the major directions of flow.

CHAPTER III

PROPOSED METHODS OF PEAK HOUR TRAFFIC FLOW REVERSAL ON THE FREEWAY

The analysis of existing traffic conditions in the study area provides the foundation for establishing methods to relieve the present traffic congestion on the freeways and to facilitate traffic flow throughout the transportation network. The reversal of traffic flow, during peak hours, on the freeways is investigated herein as a method to relieve the present congestion and to reduce travel frictions on the freeways and city streets. While there are various methods of lane reversal, only those that are likely to add to the capacity of the total traffic network without detracting from the available capacity of the freeway and city street system can be given full consideration.

The detailed analysis of traffic conditions on the freeways and on the freeway and city street interchanges provides further insight to the establishment of a system of lane reversal that would add to the qualities of the transportation network. This analysis reveals certain facts that, when properly analyzed, lead to the elimination of certain methods of lane reversal. It can also be used to establish specific conditions that must be considered prior to a discussion of a method of lane reversal that is likely to add to the qualities of the freeway and city street system.

Method Investigation

Reversal of Freeway Traffic Flow

Complete Reversal. As concluded in the detailed analysis, there is a considerable movement of vehicles from the Northwest Freeway to the Northeast Freeway, and vice-versa, during peak hours. The arrangement of arterial streets in the vicinity of the Brookwood Interchange and in the northern part of the study area limits the route offered to the vehicles making this movement to the interchange itself. A method of complete reversal of traffic flow on the Northeast Freeway (the Northwest Freeway provides sufficient capacity for vehicles at all hours) would prohibit the movement of minor flow traffic on this interchange. This, however, is not the only problem that would be encountered. Complete reversal of the Northeast Freeway would create a terminal problem and require all minor flow traffic to travel on arterial routes. The presently congested interchanges and contiguous east-west streets could not accept the traffic that would result from a terminal of lane reversal at the interchanges.

The congested parallel arterial routes would not be able to accept and provide capacity for the great traffic volumes that would be imposed upon them. Alternate routes for minor flow traffic would in many cases be of such length that travel times would be increased. The cost of effective traffic controls for such a system may limit its feasibility. Therefore, it is considered that the complete reversal of any part of the freeway system would result in the breakdown of the transportation network. Perhaps in the future, with the completion of the circumferential routes, a method of this nature could be considered.

Reversal of One Lane. There is a possibility that the reversal of one lane of the freeway would provide a suitable traffic network. It is established that no method of lane reversal is warranted on the Northwest Freeway. However, a reverse lane on the North and Northeast Freeway would provide the additional capacity that is needed in the major direction of peak hour traffic flow. The capacity offered to the minor direction of flow would be reduced, however, it is possible that a portion of this traffic could be rerouted to the parallel arterial routes that offer excess capacity in this direction. On this basis, traffic flow reversal on the freeway median lanes will be further investigated. The traffic controls and resultant effects on the minor flow traffic and arterial streets will be discussed in the final proposal.

Established Conditions

The results of the detailed analysis also make certain conditions apparent that need to be discussed and established before methods of lane reversal are proposed. These conditions are concerned with the location of the reversible lane ingress and egress points. Throughout the remainder of the discussion, the northbound ingress point shall also be the southbound egress point and they shall be referred to as a median cross-over.

Express Lane

A reversible lane to the left of the median would most likely operate more efficiently and effectively as an express lane, i.e., no intermediate median cross-over would be provided. If intermediate access were provided into and out of the reversible lane, undue congestion would result as weaving sections would be created on the freeway lanes. The reversible lane traffic would also be interrupted by such access and the purpose of the lane would be voided. Therefore, the reversible median lane shall be an express lane.

Median Cross-Overs

Finally, the location of terminal points must be considered in relation to the traffic volumes and capacities on the freeways and the physical characteristics of the freeways. The median cross-overs must be located where there is sufficient capacity to accept the funneling of traffic into and out of the express lane and where they will not hamper the free flow of traffic. They must also be located where there is a substantial desire of movement from one point to another. Since the North and Northeast Freeways are congested between Fourteenth Street and Cheshire Bridge Road, a median cross-over could not be justified between these points. However, south of Fourteenth Street the volume of traffic is 350 and 650 vehicles per hour below the capacity provided in the morning and evening peak hours, respectively. North of Cheshire Bridge Road the volume of traffic is 800 and 975 vehicles per hour below the capacity provided, respectively. Also, on the freeway north of Cheshire Bridge Road, there are over 2200 vehicles per hour traveling southbound in the morning peak hour and over 2000 traveling northbound during the evening peak hour. Over 60 per cent of these vehicles travel beyond or from beyond Fourteenth Street.

Northern Cross-Over. Since over 1500 vehicles per hour travel from north of and to north of Cheshire Bridge Road and since ample capacity is available for transition, the northern median cross-over shall be established at this location. The topography of this section is favorable to the construction of a cross-over and the vertical and horizontal roadway alignment contribute to good sight distance that would be required for the discernment of traffic control devices.

Southern Cross-Over. The location of a cross-over south of Fourteenth Street must also conform to the aforementioned criteria. The excess capacity provided just south of Fourteenth Street would not be enough to accept the funneling of traffic created by a median cross-over. Also, the section of freeway between Tenth and Fourteenth Streets is relatively short, (intersection congestion would probably occur) contains a vertical curve and has topography that would eliminate a smooth transition.

However, south of Tenth Street, but north of Fifth Street, the freeway appears to lend itself to restrictions that would be imposed by a median cross-over. There is excess capacity provided of 700 and 1000 vehicles per hour in the morning and evening peak hours, respectively. There is also sufficient sight distance provided along this section of the freeway and the topographic relief remains the same from one side of the median to the other. The cross-over would be a sufficient distance from North Avenue to create no congestion at this interchange. Therefore, a method of reversal will be proposed having this location for the southern median cross-over.

Another possible location of a median cross-over is in the Williams Street on-ramp area south of North Avenue. The North Freeway curves at this location but the topography does not change from Williams Street on ramp into the median lane of the southbound lanes. It is possible that a median cross-over at this location would serve as an ingress to the northbound express lane. The southbound express lane could continue through the Williams Street on ramp. This would necessitate the reversal of part or all of Williams Street also. Further discussion on this will appear in a later section.

A median cross-over between Williams Street and Courtland Avenue could not be given full consideration due to the curvature of the roadway and the limited sight distance produced by the closely spaced cross-street bridges. The desire for express lane travel in this area is also not great enough to warrant a terminal point.

With the established conditions in mind, the remainder of the chapter is devoted to two proposed methods of traffic flow reversal on the North and Northeast Freeways. While they may not be the only methods possible to design, they are the only ones that at this point are considered to add to the qualities of the transportation network.

Method I - Freeway Median Lane Reversal, Median Cross-Over South of Tenth Street

In this proposed method of peak hour traffic flow reversal, the median lane of the minor direction of flow traffic will be reversed and used as an express lane for the major flow traffic. During the evening peak hours, northbound traffic wishing to use the express lane will enter into it through a median cross-over 750 feet south of Tenth Street and exit from it through a median cross-over into the northbound freeway lanes 1500 feet north of Cheshire Bridge Road. The morning peak hour traffic (southbound) will repeat the transition in reverse, using the median lane of the northbound lanes as its express lane.

The express, reversible lanes would provide an additional capacity of 1200 to 1500 vehicles per hour in the major direction of flow. However, the capacity in the minor direction of flow would decrease by the same amount. The North Freeway would still provide two lanes for and sufficient capacity to the minor direction of traffic flow, but the single lane available to minor flow traffic on the Northeast Freeway would only be able to accommodate 75 per cent of the present minor flow traffic. The remaining 25 per cent of this traffic could effectively be diverted to parallel arterial routes. Since these routes do supply excess capacity to the minor direction of traffic flow, an effective control system would be established on insure the successful operation of the revised freeway system. It is also likely that the volume of traffic on the parallel arterials in the major direction of flow would decrease due to the additional capacity that would be offered by the freeways.

The successful operation of the complete revised network would depend upon the effectiveness of the controls that would be provided. Since this method of freeway lane reversal would most likely add to the total capacity of the transportation network, without detracting from the available capacity of the freeway and city street system, a comprehensive discussion of the traffic controls is warranted.

Freeway Modifications and Controls

Certain elements must be incorporated into the design of the present freeway to provide access to the reversible lanes and to minimize the possibility of congestion on the freeway due to the median cross-over transition and accidents that may occur. Effective traffic control devices, signs, signals, etc., must also be provided to increase the efficiency of the reversible lanes and maximize the obedience of lane controls.

Median Cross-Overs. Ingress to and egress from the reversible lanes will be provided by median cross-overs at the locations previously established, 1500 feet north of Cheshire Bridge Road and 750 feet south of Tenth Street. The cross-over will be designed in accordance with the design of tapers for acceleration and deceleration lanes as specified in "A Policy on Geometric Design of Rural Highways," American Association of State Highway Officials, 1955. Assuming a design speed of 60 mph and an average running speed of 45 mph, the minimum length of taper would be 200 feet. This length would be sufficient to provide smooth transition from one side of the freeway to the other, through the median cross-over, at a speed of 40 to 50 mph, thus minimizing congestion. The taper would continue through the median lane for an over-all length of about 370 feet.

The medians at both locations are 14 feet wide. The cross-overs will be constructed by removing a 370-foot section of the median and replacing it by roadways connecting the opposite sides of the freeway. One roadway would complete the ingress transition, the other would complete the egress transition. With the roadways thusly constructed, the maximum opening on the centerline of the median would be about 180 feet. The median could then be tapered from the 370-foot limit to the 180-foot limit, on each side of the cross-over, as shown in Figure 16.

A barrier will be provided across the median cross-over during off-peak hours to prohibit unauthorized crossings. This barrier could be in the form of a vertical lift gate structure or net, a horizontally moving gate structure or net or any device which could be readily removed. The barrier could be moved manually or automatically. Horizontal swing arms could also be provided on the noses projecting into the cross-overs. These arms would swing perpendicular to and extend to the edge of the freeway lanes when the cross-over is closed. During peak hours they would swing against the noses and out of the way to permit entry into the cross-over. See Figure 16.

Opposing Flow Lane Dividers. During the peak hours, it would be necessary from a safety standpoint to separate the reverse lane traffic from the minor flow traffic and provide barriers to funnel major flow traffic out of the express lanes and minor flow traffic away from the express lane. This may be done by traffic cones and automatic

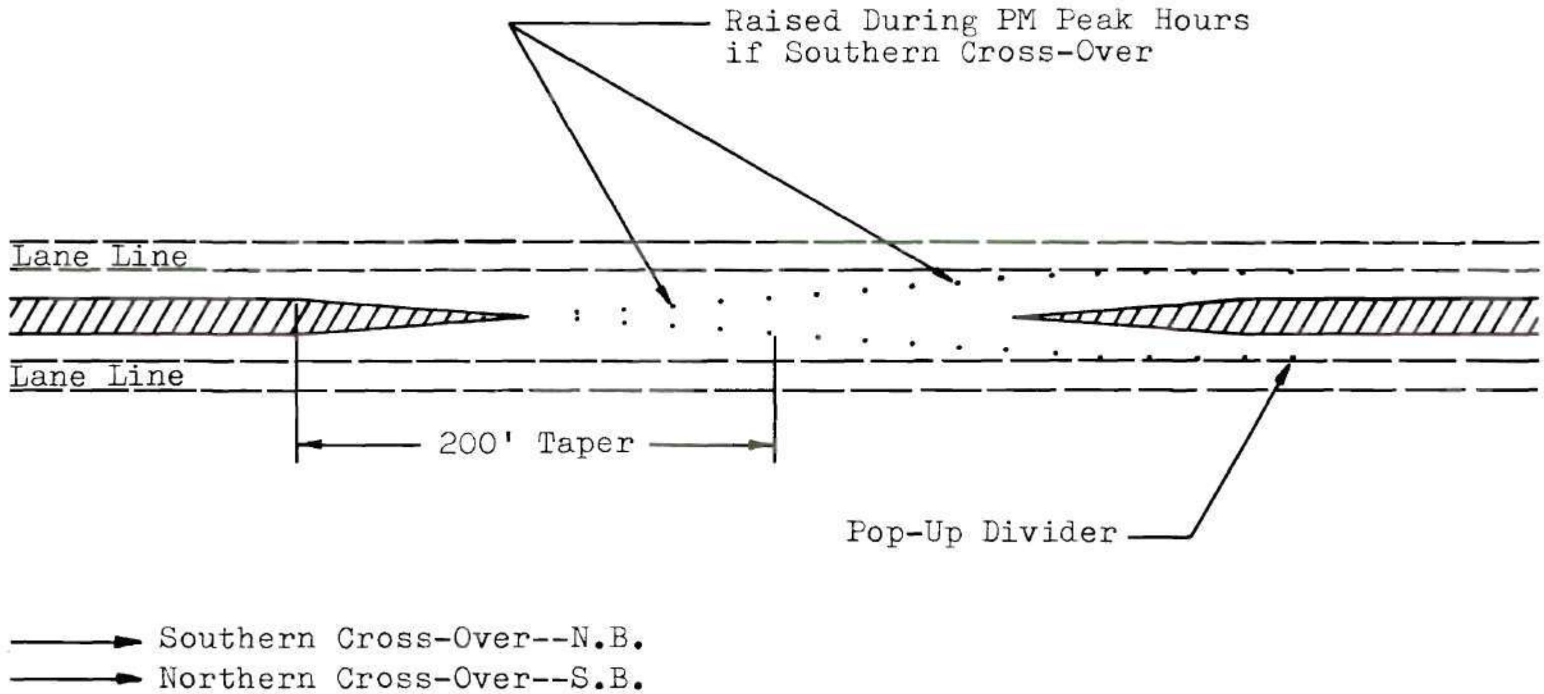


Figure 16. Freeway Median Cross-Over for Reversible Flow

pop-up lane dividers. The traffic cones would have to be placed and removed manually. The automatic pop-up lane dividers are tubes, 13 inches high when projected above the pavement. When not in use they retract into and flush with the pavement.

The traffic cones would be located between the reversed lane and the adjacent minor flow freeway lane for the total length of the express lane, 4.75 miles. They should be placed 150 feet apart to provide lane separation with maximum safety. Near the egress end of the express lane automatic pop-up lane dividers would be placed about 20 feet apart, across the end of the express lane, to funnel opposing minor flow traffic away from the lane. See Figure 16. The automatic pop-up lane dividers may be installed along the total length of the express lane at some later date.

<u>Refuge Bays and Emergency Cross-Overs</u>. In the event of an accident or vehicle breakdown on the minor flow lane of the Northeast Freeway or the express lane, refuge bays and emergency median cross-overs will be constructed. An accident or breakdown would halt the flow on these roadways. However, with refuge bays or shoulder pull-offs provided on the Northeast Freeway, the vehicle could be pushed or towed to a refuge to permit traffic to proceed. Emergency cross-overs through the median would provide a refuge bay for vehicles broken down or involved in an accident on the

express lane while it would offer access to such incidents for emergency vehicles. Unauthorized entry could be prohibited by movable barriers and/or signing.

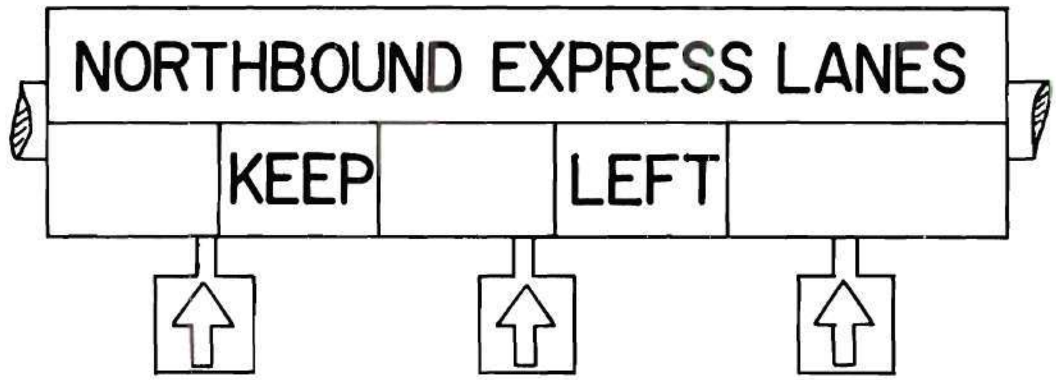
Traffic Control Signs and Signals. As pointed out in the "Manual on Uniform Traffic Control Devices," U. S. Department of Commerce, Bureau of Public Roads, no standard signs applicable to reversible flow have been developed. This same condition applies to Interstate Route signing. The signs proposed herein, however, will conform to the specifications of the "Manual for Signing and Pavement Marking of the National System of Interstate and Defense Highways," A.A.S.H.O. For maximum visual understanding of the freeway traffic controls, overhead signs are considered. It is possible that the reversible system could function without such a complete system of signs and lane signals; however, for a full understanding of the operation of the proposed system, a comprehensive traffic control technique is discussed. It is considered to be the safest and most effective method of controlling the freeway traffic.

During peak and off-peak hours, lane control signs are necessary to indicate the status of the express lanes. Optimum spacing of the signs must be achieved to provide sufficient time and distance for vehicles to choose their course of travel. The operation of the signs will vary as is required at different locations, but all signs will be illuminated and operate automatically. Various techniques will be employed, such as changeable message signs, blank-out message signs and vertical lift signs. Lane signals may also be attached below the signs to provide maximum effectiveness.

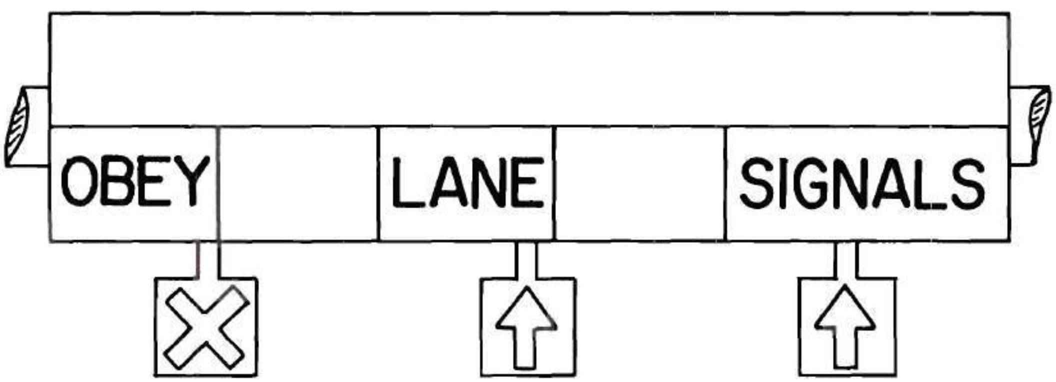
The express lane traffic control signs for morning peak hour traffic would be the same as those for evening peak hour traffic with the exception of the terms "Southbound" and "Northbound" at the respective ends of the express lane. Near the southern cross-over the signs will control three lanes while near the northern cross-over they will control only two lanes. For this reason, the discussion and figures will be limited to signs applicable to the southern cross-over. The sign messages and locations are considered to be the most effective ones to provide freeway lane control in conjunction with the operation of the express lanes.

The signs shown in Figures 17 through 19 will face northbound traffic south of the entrance to the northbound express lane. The sign in Figure 17 will be partially blank-out, as shown. During off-peak hours it will be totally blank-out. The sign in Figure 18 will be partially changeable message and partially vertical lift gate. The sign in Figure 19 will operate similar to the one in Figure 18. These three signs will inform northbound traffic of the condition of the express lane and its ingress point.

The signs shown in Figures 20 through 22 will face southbound traffic north of the exit from the southbound



PM Peak Hours



AM Peak Hours

Figure 17. Reversible Express Lane Traffic Control Sign--0.4 Miles Prior to Express Lane Cross-Over (Entrance) (Changeable Message Sign)

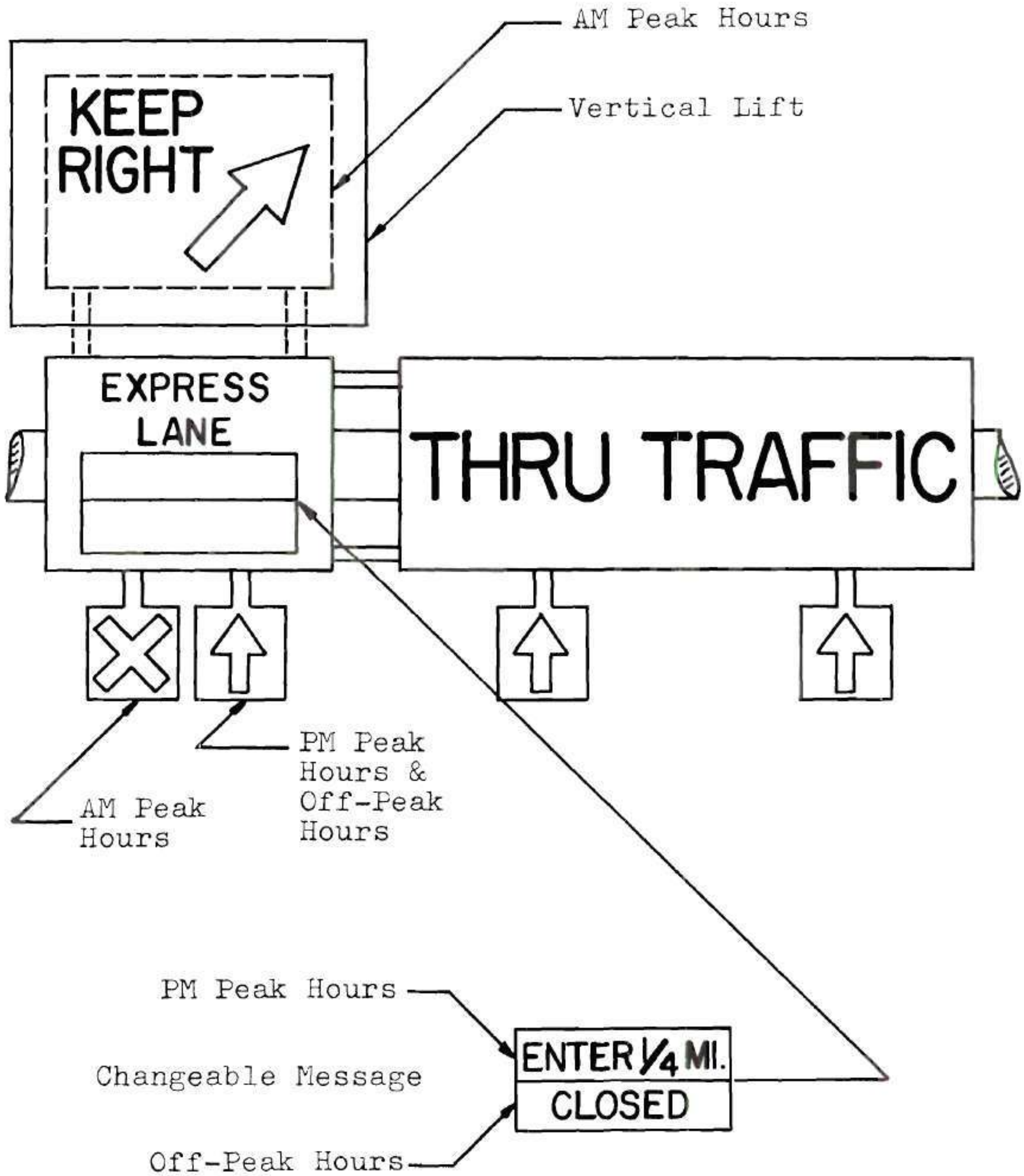


Figure 18. Reversible Express Lane Traffic Control Sign--0.25 Miles Prior to Express Lane Cross-Over (Entrance)

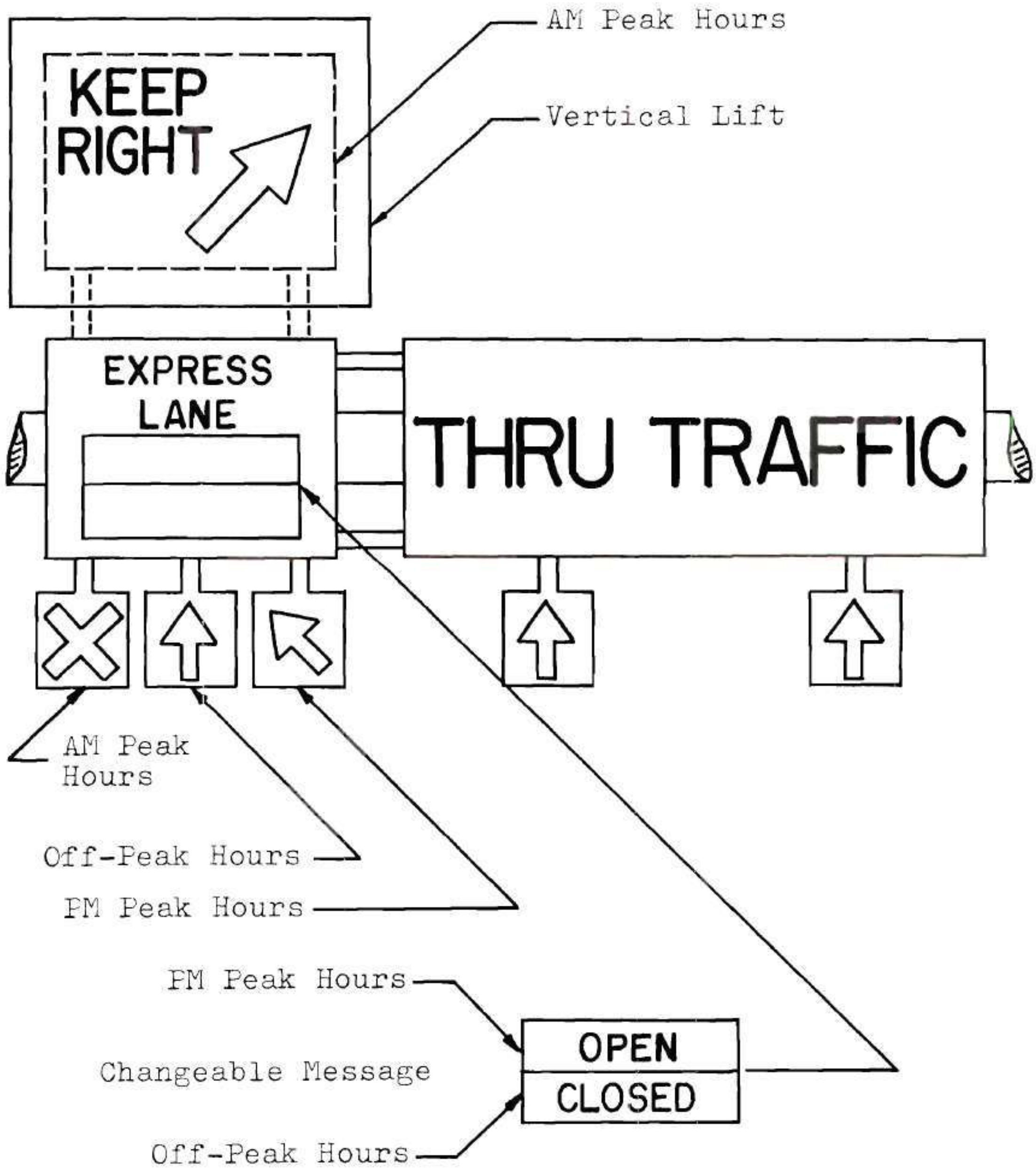
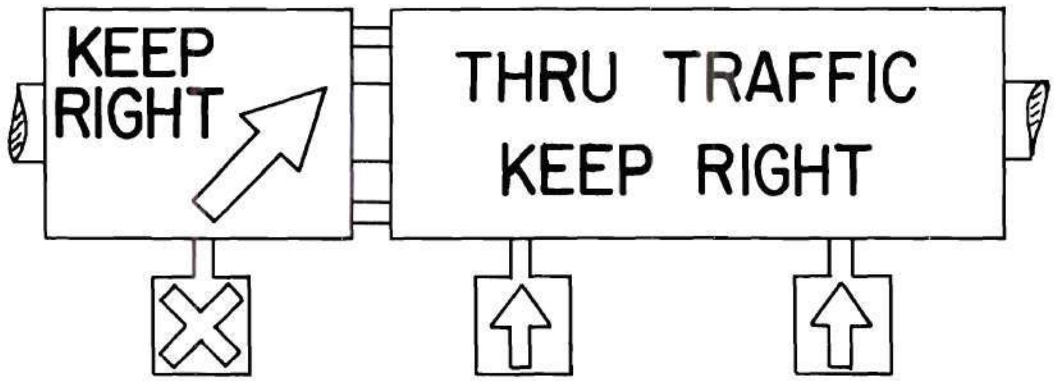
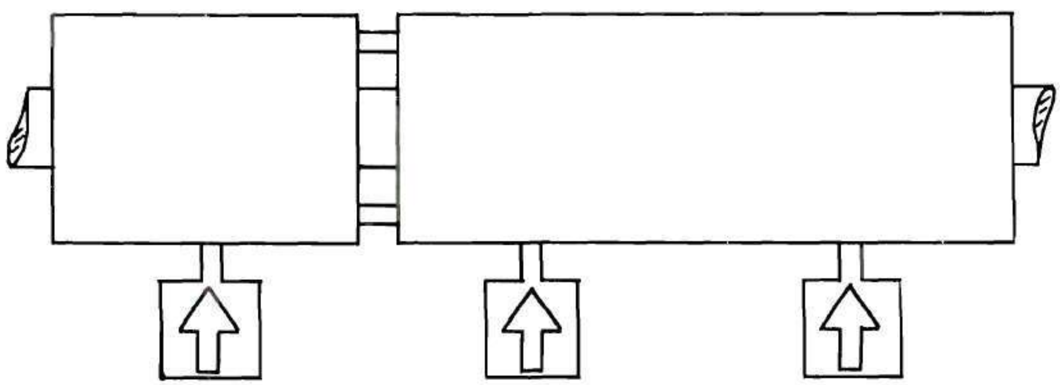


Figure 19. Reversible Express Lane Traffic Control Sign--100 Feet Prior to Express Lane Cross-Over (Entrance)

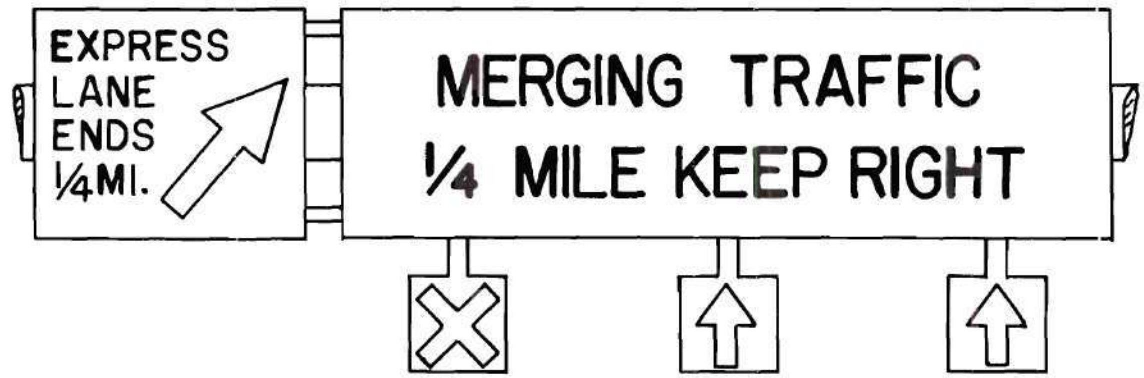


PM Peak Hours

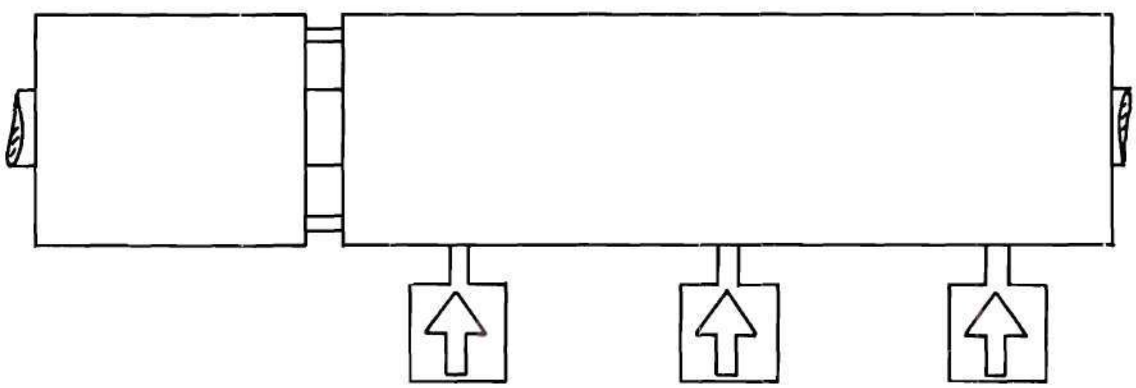


AM and Off-Peak Hours

Figure 20. Reversible Express Lane Traffic Control Sign--200 Feet South of Each on Ramp Between Express Lane Cross-Overs (Changeable Message Signs)

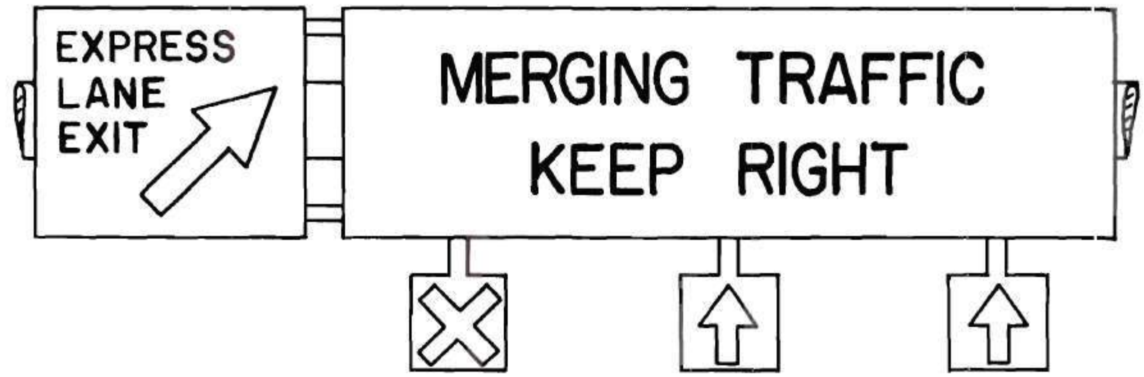


AM Peak Hours

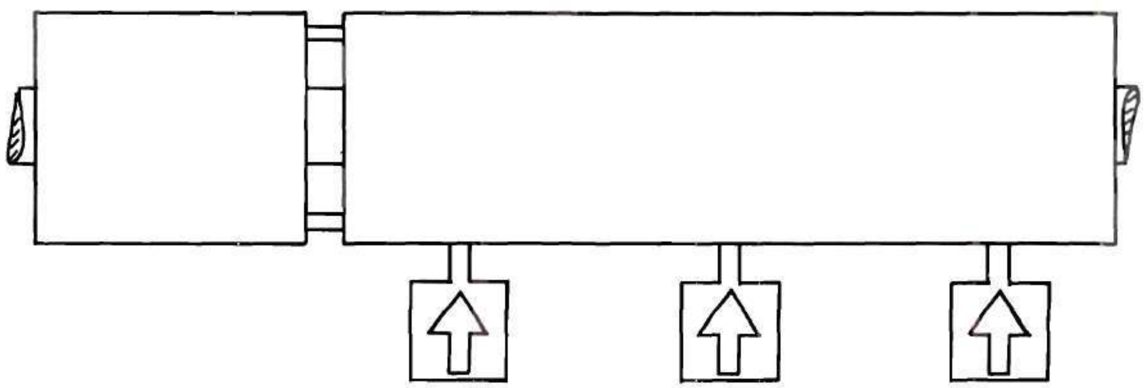


PM and Off-Peak Hours

Figure 21. Reversible Express Lane Traffic Control Sign--0.25 Miles Prior to Express Lane Cross-Over (Exit) (Changeable Message Sign)



AM Peak Hours



PM and Off-Peak Hours

Figure 22. Reversible Express Lane Traffic Control Sign-100 Feet Prior to Express Lane Cross-Over (Exit) (Changeable Message Sign)

express lane. The sign in Figure 20 will function to inform vehicles entering the minor direction of flow that the median lane is operating under reverse conditions. It will be a "blank-out" type sign. The signs in Figures 21 and 22 will operate only during peak hours. These three signs will inform southbound traffic of the operation and termination of the express lane.

The illumination of the signs will be provided by flourescent lighting behind the messages. The signals attached below the signs provide maximum lane control. They will be black indicators on an illuminated red or green background as applicable. The "blank-out" technique and the dual-changeable message technique are one in the same. The sign actually contains two messages. When one is required, the other is blanked out, i.e., the lighting operates behind only one message at a time. When neither is needed, as in off peak hours, the complete sign is blanked out. The vertical life sign, on the other hand, provides three messages for three different periods of operation. One of the lift signs will be a changeable message sign for two periods of operation. The other vertical lift sign will be used in the third period of operation. When one of the two lift signs is not in use it will retract into the blank cover above the other sign.

Signs will also be placed near emergency median crossovers and refuge bays informing traffic of their existence and warning traffic not to misuse them.

Control System. The lane reversal physical control (signs and signals) will operate automatically by radio control. Local controllers will be provided where needed and a master controller will be located in the CBD to provide complete surveillance of the system operation.

The reverse lane system will be in operation from 6:45 A.M. to 9:15 A.M. and from 3:45 P.M. to 6:15 P.M. The regulatory signs and signals and the reverse lane controls will be activated in sequence beginning with those for the minor direction of flow. At 6:30 A.M. the signs and signals facing the northbound traffic will be activated and flash for five minutes, then operate continuously. At 6:35 A.M. the automatic lane dividers will pop up and traffic cones will be placed beginning at the southern end of the express lane. Time will be allowed for vehicles to comprehend the signs along the freeway, especially near the on ramps, and clear the lane to be reversed. The southern cross-over, express lane exit, will be opened at this same time. The regulatory signs for the express lane will then begin operation in sequence starting with the ones near the exit. Also, at 6:43 A.M. the northern cross-over, express lane entrance, will be opened. The signs prior to this cross-over, facing southbound peak hour traffic, will then be activated beginning with the one nearest the cross-over. The activation of the system will be complete by 6:45 A.M. As the system is activated in reverse, the activation of each successive control will depend upon the proper activation, and confirmation of such activation, of the previous control. In the event of the failure of the automatic system, mechanical operation of the controls will be provided at each local controller.

At 9:00 A.M. the closing of the reverse lane system will begin. The closing sequence will be the reverse of the opening sequence. The ingress end of the express lane will be closed at 9:00 A.M. The remainder of the system will be deactivated 15 minutes later, allowing time for the last vehicle in the express lane to exit from it. The reverse lane system will operate similarly in the evening peak hour.

City Street Modification and Traffic Control

As revealed in the previous chapter, the present city street system carries traffic in excess of the capacity provided in almost all areas near the freeways. The existing traffic control devices are considered to be inadequate to handle the arterial traffic. With the freeway operating under the proposed lane reversal system, better traffic controls would be required on the city streets to complement the freeway system and add to the capacity of the total transportation network.

The arterial routes parallel to the North-Northeast Freeway would assist the freeway in handling the minor direction of flow traffic during peak hours. At the same time, the amount of traffic in the major direction of flow on these arterials would decrease. This effect on the city street system will be overcome by more effective traffic control devices.

The arterial routes in the vicinity of the termini of the express lanes will be signed and signaled to direct express lane traffic to the freeway and reroute much of the minor flow traffic. During the evening peak hours an effort will be made to divert southbound freeway traffic to the parallel arterial routes at the Cheshire Bridge Road interchange and the Piedmont Road interchange. Signs will be posted on the freeway, north of Cheshire Bridge Road. They will recommend that trucks and business-district-bound vehicles exit from the freeway during evening peak hours and travel Cheshire Bridge Road and Piedmont Road as an alternate route. The same type of signs will be placed north of the piedmont Road interchange to attempt to further decrease the load in the restricted minor flow direction. Signs will also be posted on Cheshire Bridge and Piedmont Roads in the vicinity of the freeway to recommend these routes into the city rather than the expressway. This effectively would reduce the volume of traffic on the single freeway minor flow lane.

A relatively new traffic control method could be used to divert traffic from the freeway and supplement the signs. A method that is used in London, Automatic Traffic Diversion, would be applicable to this situation. An apparatus will be placed on the freeway minor flow lane that detects the presence of vehicles and distinguishes between a moving line of traffic and one that is standing still. When the standing line of traffic extends beyond a certain point to the detector, a light will appear on a diversion sign in the form of a flashing arrow that refers to the direction of the alternate recommended route. Although the route may be longer it will ultimately save time to the motorist. The signs with the lighted arrows could be placed on the freeway north of the two interchanges previously discussed and on the city streets in the vicinity of the interchanges. (28)

The increased volumes on the arterial streets, Cheshire Bridge and Piedmont Roads, in the minor direction of flow will be provided with sufficient capacity. As discussed, these streets do have excess capacity in this direction. To further increase this capacity and maintain efficient traffic flow, these arterials will be supplied with automatic traffic control devices. It is proposed that all intersections of these arterial routes into the city be signaled by automatic volume density traffic signal controllers. The detection of traffic volumes will be made and transferred to the signal controllers by magnetic detectors in the approach lanes and overhead radar detectors near the intersections. The control equipment operates so that the right of way remains continuously on the street which used it last until called by traffic on another street. A maximum pre-selected green time is alloted for each approach. The flow of traffic governs the green time, otherwise. On the two routes, approximately 12 of these signals and detectors would be required at the intersections.

During the morning peak hours, the same procedures will be established near the southern terminus of the freeway lane reversal. In this case, the freeway south of North Avenue, Tenth Street, and Fourteenth Street will be similarly signed. Also, Williams Street and Piedmont Avenue near the CBD and North Avenue, Tenth Street, and Fourteenth Street near the freeway will be provided with the signing and diversion control to reroute traffic from the freeway minor flow lanes to Piedmont Avenue and other parallel arterial routes. Additional automatic traffic signals will be provided on these routes to increase the efficiency of traffic movement.

Since the revised freeway system would affect the traffic movement throughout most of the study area, it is considered that all intersections of major arterials be provided with automatic volume density traffic signals and detectors. The total number of signals required at these major intersections would be between 40 and 50. Lane markings and overhead signing would act to complete the transition.

Estimated Traffic Conditions

With the proposed complete system in operation, sufficient capacity would be provided throughout the transportation network. At the initial installation of such a system, some degree of congestion is likely, due to misunderstandings of the motorists. However, through proper police measures and through communication media the public would rapidly become accustomed to the system. The public must be informed of the implications.

An estimated 1200 vehicles per hour will use the express lane during peak hours. From 1200 to 1500 vehicles per hour would probably be on the single minor flow lane of the Northeast Freeway. The minor flow lanes on the North Freeway and the freeway major flow lanes would operate under capacity. The arterial streets would be operating near capacity in the minor direction of flow; however, the major direction of flow would probably be less than capacity available. At the time when the system is in operation and the traffic can be sampled, it may be necessary to convert some of the arterials into one-way streets or provide off-center lane movements. These conditions could only be determined after the system is in operation and are not considered in detail in this analysis.

Cost Analysis

Due to the limitation on available cost information, the capital investment in the system can only be approximated. The cost of the various items of the proposed system and the total initial investment is shown on Table 4. The over-all

Table 4. Approximate Cost Analysis for Method I

Northern Median Cross-Over:		
Construction	$ 6,000	
Barrier Gate	9,000	
Horizontal Swing Arms	2,400	
Local Controller and Wiring	1,600	
Installation of Controls	2,000	$21,000
Southern Median Cross-Over:		
Construction	8,000	
Barrier Gate	9,000	
Horizontal Swing Arms	2,400	
Local Controller and Wiring	1,600	
Installation of Controls	2,000	23,000
Lane Dividers, Automatic Pop-up:		
Approximately 64 @ $13.00	832	
Local Controller and Connectors	1,500	2,332
Lane Dividers, Traffic Cones:		
350 @ $5.00	1,750	1,750
Refuge Bays and Emergency Cross-Overs:		
Refuge Bays - 16 @ $600	9,600	
Emergency Cross-Overs - 8 @ $500	4,000	13,600
Overhead Signs and Lane Signals:		
Changeable Message Signs 8 @ $2000 average	16,000	

Table 4. Approximate Cost Analysis for Method I (Continued)

Vertical Lift Signs 4 @ $3000 average	12,000	
Lane Signals 38 @ $30 average	1,140	
Sign Structures 12 @ $2000 average	24,000	
Two Local Controllers and Wiring @ $2200	4,400	
Installation of Controls	10,000	$67,540
Master Controller for Freeway System (Radio Control)	15,000	15,000
City Street Major Intersection Controls:		
Two-Phase Full-Actuated Volume-Density Controller approximately 45 @ $1440 (No master controlled needed)	64,800	
Radar Vehicle Detectors approximately 180 @ $440	79,200	
Wiring and Installation	27,000	171,000
Traffic Diversion Controls		
5 @ approximately $1000	5,000	5,000
TOTAL APPROXIMATE COST		$420,222

Sources: Georgia State Highway Department

Automatic Signal Division
Eastern Industries, Inc.
Norwalk, Connecticut

Minnesota Mining and Manufacturing Co.
St. Paul 6, Minnesota

Washington State Department of Highways

cost could be reduced by increments depending upon the degree of performance that is desired. Various manual operations could be introduced in place of the automatic system. Police control could take the place of some signing and signaling.

Compared to the cost of constructing additional freeway lanes or additional freeways, the cost of this proposed system is not prohibitive. The benefits would be in the form of reduced travel times, reduced congestion, increased travel speeds, and reduced vehicle operation costs.

Method II - Freeway Median Lane Reversal, Williams Street Area Terminal

In this method of peak hour traffic flow reversal, the median lane of the minor direction of flow traffic will be reversed and used as an express lane for the major flow traffic. Williams Street, north of Cain Street, and the Williams Street on ramp will also operate as reversible roadways. During the evening peak hours, northbound traffic wishing to use the express lane will enter into it through a median cross-over at the merger of the Williams Street on ramp and the North Freeway and exit from it through a median cross-over onto the northbound freeway lanes 1500 feet north of Cheshire Bridge Road. The morning peak hour express lane traffic, entering the express lane north of Cheshire Bridge Road, will not cross the median at the southern terminal.

The southbound express lane will continue through the Williams Street on ramp and Williams Street. The ramp and Williams Street to Cain Street will be one-way south during the morning peak hours.

The express reversible lane would have approximately the same effect on the traffic volume and capacity of the freeways that it had in the first method. The arterial streets would also be similarly affected, with the exception of those near the southern terminal. This method of lane reversal would provide the needed, additional capacity (3000 vehicles per hour) to freeway traffic exiting at Williams Street during the morning peak hours. During the evening peak hours, the smooth, almost direct-line transition into the express lane would also reduce the congestion on the Williams Street on ramp.

During the morning peak hours, Spring Street would be converted to a one-way north street from Harris Street to Fourteenth Street to accommodate the vehicles wishing to enter the North Freeway minor flow or continue on the parallel arterial routes. More than sufficient capacity would be provided in this manner for the over 1000 vehicles per hour normally using the Williams Street on ramp and the 500 vehicles per hour that travel northbound on Spring Street. The 700 to 800 vehicles per hour that normally travel south on Spring Street during the morning peak hours could effectively be carried by the freeway and parallel arterial routes.

The successful operation of this revised transportation network would depend upon the effectiveness of the controls provided. Since this method would most likely add to the total capacity of the transportation network, it could be considered as a minor revision of the first method.

The freeway signing and other reverse lane controls would be almost identical to the ones in the first method. The reversal of Williams Street and Spring Street is a problem dealing with city streets. Such a problem is not difficult to solve. Since it deviates from the purpose of this report, it will not be considered in detail. Suffice it to say that controlling such a city street system revision could effectively be handled by the City Traffic Engineering Department and the State Highway Department of Georgia.

CHAPTER IV

SUMMARY OF RESULTS, RECOMMENDATIONS AND CONCLUSIONS

Results

The following significant results were obtained in this analysis.

1. Due to the movement of traffic on the Brookwood Interchange, a method of complete freeway reversal is considered infeasible.

2. Due to the considerable amount of freeway minor flow traffic and the existing congestion near the freeway interchanges, a terminal for lane reversal located at an interchange is considered infeasible.

3. The volume of traffic on the Northwest Freeway compared to the capacity provided warrants no lane reversal on this freeway.

4. The reversal of the median lanes of the North and Northeast Freeways is considered to provide the necessary additional capacity and not to detract from the capacity of the total network.

5. The reversible median lane is established as an express lane to prohibit congestion that would result with intermediate interchanges.

6. Considering the desire for travel and the freeway volumes encountered, the northern ingress and egress

point of the express lanes has a proposed location 1500 feet north of Cheshire Bridge Road through the median and the southern ingress and egress point of the express lanes has a proposed location 750 feet south of Tenth Street through the median.

7. An alternate location of the southern median cross-over could be in the Williams Street on-ramp area with portions of Williams Street and Spring Street reversed during the morning peak hours.

8. A method of lane reversal on the North and Northeast freeways is proposed and discussed in detail with the southern median cross-over 750 feet south of Tenth Street.

9. The cost of the proposed method of freeway lane reversal is $420,000.

10. An alternate method of lane reversal on the North and Northeast Freeways is proposed and discussed briefly with the express lane terminal in the Williams Street area.

Conclusions

The reversal of peak hour traffic flow on the North and Northeast Freeways is considered to be feasible with the proposed Method I in operation. The vehicular speed on the single minor flow lane of the Northeast Freeway will probably be reduced to 35 mph. The over-all speed on the major flow lanes should increase from 27 mph to 35 to 40 mph.

The cost of the proposed system of lane reversal is

$420,000 for all signs, signals, express lane controls, arterial street intersection traffic signals and their installation.

Recommendations

The following recommendations are made concerning the methods of lane reversal on the North and Northeast Freeways:

1. Establish a method of freeway lane reversal during peak hours as discussed in Method I.

2. Construct median cross-overs north of Cheshire Bridge Road and south of Tenth Street.

3. Provide a movable barrier gate across the median openings at the cross-overs to prohibit the entry of unauthorized off-peak traffic.

4. Separate the opposing lanes of freeway traffic (express lane from others) by automatic pop-up lane dividers near the cross-overs and traffic cones 150 feet apart between the cross-overs.

5. Construct refuge bays and emergency median cross-overs every one-half to one mile between the express lane cross-overs.

6. Provide overhead signing and lane control signals for the express lane traffic control and for maximum effectiveness.

7. Place all freeway signs, signals, and express lane

physical controls under an automatic control system, controlled by master controllers, which may be operated manually in the event of an emergency.

8. Sign the city streets in the vicinity of the median cross-overs to divert minor flow traffic from the freeways to the parallel arterial routes.

9. Install automatic volume density traffic signals with master controllers at all major arterial intersections in the study area to provide maximum effectiveness of system operation.

10. Change city streets to one-way routes or off-center lane movements if found to be necessary after the reversal freeway system is in operation.

11. Investigate the possibility of establishing a southern express lane terminal in the Williams Street area by reversing sections of Williams Street and Spring Street.

APPENDIX

Table 5. Population of Counties Containing and/or Surrounding the Study Area

Year	County				Total
	Cobb	DeKalb	Fulton	Gwinnet	
1950	61,830	136,395	473,572	32,320	704,117
1960	114,174	256,782	556,326	43,541	970,823
1961 (estimate)	119,800	267,700	567,100	44,800	999,400

Source: Atlanta Chamber of Commerce

Table 6. Registered Passenger Vehicles of Counties Containing and/or Surrounding the Study Area

Year	County				Total
	Cobb	DeKalb	Fulton	Gwinnet	
1950	14,603	38,965	147,020	6,582	207,170
1951	17,072	44,958	134,086	7,272	203,388
1952	19,482	49,530	142,260	7,726	218,998
1953	21,903	54,524	151,777	8,340	236,544
1954	25,795	58,932	158,141	9,413	252,281
1955	32,210	69,145	170,595	10,658	282,608
1956	31,550	75,568	163,664	11,186	281,968
1957	34,278	81,019	168,243	11,795	295,335
1958	35,338	86,090	171,214	12,656	305,298
1959	39,632	93,634	180,857	13,762	327,885
1960	42,562	100,392	188,629	14,692	346,275
1961	45,980	106,451	194,767	15,750	362,948

Source: Georgia State License Tag Bureau.

Table 7. Registered Passenger Vehicles and Trucks in 1961 of Counties Containing and/or Surrounding the Study Area

Vehicle Type	County				Total
	Cobb	DeKalb	Fulton	Gwinnet	
Passenger Cars	45,980	106,451	194,767	15,750	362,948
Trucks	5,782	7,493	22,239	3,197	38,711
Total					401,659

Source: Georgia State License Tag Bureau

Table 8. Peak Hour Traffic Volume as a Per Cent of the Total Daily Traffic Volume and Per Cent Directional Split from a Typical Count at Peachtree Major Control Station

Average 2-Way Weekday Volume	P.M. 2-Way Peak Volume*	Peak as a Per Cent of Total Volume	Peak Volume (Outbound)	Outb. Vol. Per Cent of Peak Volume	Opposite Volume (Inbound)	Inb. Vol. Per Cent of Peak Volume
33,758	2,745	8.15	1,700	61.9	1,045	38.1
Approximate		8.0		60.0		40.0

*A.M. Peak Volume calculations approximately the same.

Source: Georgia State Highway Department

Table 9. Peak Hour Traffic Volume as a Per Cent of the Total Daily Traffic Volume and Per Cent Directional Split from a Typical Count North of 14th Street on the North Freeway

Average 2-Way Weekday Volume	P.M. 2-Way Peak Volume	Peak as a Per Cent of Total Volume	Peak Volume (Outbound)	Outb. Vol. Per Cent of Peak Volume	Opposite Volume (Inbound)	Inb. Vol. Per Cent of Peak Volume
83,508	7,284	8.72	4,308	59.2	2,976	40.8
Approximate		9.0		60.0		40.0

Average 2-Way Weekday Volume	A.M. 2-Way Peak Volume	Peak as a Per Cent of Total Volume	Peak Volume (Inbound)	Inb. Vol. Per Cent of Peak Volume	Opposite Volume (Outbound)	Outb. Vol. Per Cent of Peak Vol.
83,508	7,249	8.68	4,940	68.1	2,309	31.9
Approximate		9.0		65.0		35.0

Source: Georgia State Highway Department

Table 10. Typical Adjustment of Peak Hour Traffic Volumes to 1961 Average Weekday Peak Volume (Piedmont Avenue, Northbound)

Location of Count	Peak Hour Volume Major (N.B.)	Peak Hour Volume Minor (S.B.)	Month	Expansion Factor to Divide By	Adjusted Peak Hour Volume Major (N.B.)	Adjusted Peak Hour Volume Minor (S.B.)
North of Baker Street	1,126	(one-way)	Nov.	1.040	1,038	(one-way)
South of North Avenue	1,016	(one-way)	May	0.963	1,055	(one-way)
North of North Avenue	824	294	May	0.963	856	305
North of Ponce de Leon Avenue	659	363	May	0.963	684	377
South of 10th Street	520	260	May	0.963	540	270
North of 10th Street	600	284	May	0.963	623	295
South of 14th Street	872	699	Mar.	0.960	908	728
North of 14th Street	942	691	Mar.	0.960	981	720
@ Southern R.R.	1,251	474	May	0.963	1,300	492
South of Cheshire Bridge Road	1,361	664	May	0.963	1,413	690
North of Northeast Freeway	1,048	699	Feb.	0.962	1,089	727
South of East Paces Ferry Road	1,008	380	Mar.	0.960	1,050	396

Source: Atlanta Traffic Engineering Department

Table 11. CBD Cordon Inbound and Outbound 24-Hour Totals and A.M. and P.M. Peak Hours

Location	Inbound 24-Hour Totals	Inbound 7-9 A.M.	Outbound 24-Hour Totals	Outbound 4-6 P.M.
Piedmont Avenue			11,581	1,978
Courtland Avenue	28,638	5,756		
Ivy Street*	6,572	910	3,688	599
Peachtree Street	7,541	796	8,996	1,155
W. Peachtree Street	5,331	665	7,887	1,079
Spring Street	8,077	1,289	8,241	1,365
Baker Street			3,460	562
Harris Street	6,618	985		
Cain Street			4,981	614
Carnegie Way	4,480	882	3,923	526
Williams Street			2,258	503
Luckie Street			5,633	1,012
Nassau Street	1,519	221		
Walton Street	6,170	1,012		
Marietta Street	13,289	1,900	11,965	1,850
Total	88,235	14,416	72,613	11,243
Peak as Per Cent of Total		16.34		15.48

*Recently changed to one-way north.

Source: Georgia State Highway Department

Table 12. Southern Railroad Screen Line
Inbound and Outbound 24-Hour Totals
and A.M. and P.M. Peak Hours

Location	Inbound 24-Hour Totals	Inbound 7-9 A.M.	Outbound 24-Hour Totals	Outbound 4-6 P.M.
Piedmont Avenue	8,994	2,597	8,642	2,092
Montgomery Ferry	4,130	1,722	3,872	1,528
Northeast Freeway	28,613	5,624	29,931	5,836
Peachtree Street	17,653	3,235	16,045	2,941
Northwest Freeway	18,520	4,642	18,421	4,196
Northside Drive	8,814	1,899	10,262	2,398
Howell Mill Road	6,660	1,046	7,535	1,568
West Marietta Street West of Ashby Street	8,413	1,574	7,775	1,561
Total	101,797	22,339	102,483	22,120
Peak as Per Cent of Total		21.94		21.58

Source: Atlanta Traffic Engineering Department

Table 13. Typical Travel Time Study, P.M. Peak Hour (North, Northeast and Northwest Freeways)

Control Section Termini	Northeast Freeway Run*			Northwest Freeway Run*			Average	
North Freeway	m s	m s	m s	m s	m s	m s		m s
Piedmont Avenue	0:00	0:00	0:00	0:00	0:00	0:00		0:00
North Ave. Off Ramp	0:49	1:00	1:05	1:00	1:01	1:08		1:01
North Ave. On Ramp	(not taken)	1:18	1:25	1:19	1:16	1:55		1:26
10th Street Off Ramp	2:01	2:15	2:12	3:52	2:14	4:00		2:48
10th Street On Ramp	2:48	3:00	2:35	4:46	3:40	5:01		3:38
14th Street Off Ramp	3:40	3:30	3:04	5:16	4:15	5:42		4:14
14th Street On Ramp	4:45	4:12	3:25	5:51	5:30	6:17		5:00
N.E.-N.W. Junction	5:24	5:36	3:53	6:30	6:05	6:58		5:44
Northeast Freeway							N.E.	N.W.
Peachtree Off Ramp (south)	6:15	7:32	5:49				6:32	
Peachtree On Ramp	6:46	8:06	6:26				7:06	
Piedmont Off Ramp (south)	10:06	data	8:48				9:27	
Piedmont Off Ramp (north)	11:02	not	9:32				10:17	
Cheshire Bridge Off Ramp	12:28	taken	11:03				11:45	
North Druid Hills	14:30	14:14	12:37				13:47	

Table 13. Typical Travel Time Study, P.M. Peak Hour (North, Northeast and Northwest Freeways) (Continued)

Control Section Termini	Northeast Freeway Run*	Northwest Freeway Run*			Average
Northwest Freeway					
Northside Off Ramp		8:08	7:48	8:38	8:11
Howell Mill Off Ramp		8:40	8:17	9:07	8:41
Moores Mill Off Ramp		11:26	10:54	11:35	11:18

*Due to maintaining proper lanes on North Freeway to get to either the Northeast or Northwest Freeway, the travel times are different but are averaged for ease in presentation on the contour maps.

Source: Project B-190, Georgia Tech Engineering Experiment Station

Table 14. Typical Traffic Signal Green Time Calculation and Average Lane Widths for Use in Capacity Study (Peachtree Street)

Control Section	Signal Green Time	Signal Red Time	Ratio: Green/Tot. Time		
CBD to North Ave.	38.5	31.5	0.55	2 of 11 ft. to Forrest Avenue then 3 of 10 ft.	2 of 11 ft. from Forrest Avenue 2 of 10 ft. before
North Ave. to Tenth St.	35.0	35.0	0.50	2 of 10 ft.	2 of 10 ft.
Tenth St. to Fourteenth Street	32.0	48.0	0.40	1 of 10 ft. 1 of 20 ft. (with parking)	1 of 10 ft. 1 of 20 ft. (with parking)
Average			0.48		
Approximate			0.50		

Source: Atlanta Traffic Engineering Department

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